ENGINEERING NEWS

THE Tennessee & Coosa Railroad Company of Alabama has just been reorganized; a majority of the stock having been purchased by New York capitalists, and arrangements have been made for a prompt completion of the road.

The grading on 36 miles of the road from Gadsden, on the Coosa river, to Guntersville (Wyeth City), on the Tennessee river, was nearly completed before the War of the Rebellion. Track has been laid, and the road is in operation from Gadsden to Littleton, 11 miles, crossing the Alabama Great Southern (C. N. O. & T. P.) at Attalla. The line has been extended and surveys made from Guntersville to Huntsville, Ala., 40 miles, crossing the Tennessee river near Guntersville, the city of Huntsville having promptly raised over $80.000 by subscription at a public meeting April 5th to secure the location *via* that city.

Proposals for completing the road, including an iron bridge over the Tennessee river near Guntersville, will be invited at once. Mr. E. A. QUINTARD, 69 Wall Street, New York, is President, and WILLIAM H. CASE, of the firm of Case & Crozer, Knoxville, Tenn., is Chief Engineer, with office and headquarters at Gadsden, Ala. The road traverses a rich agricultural, timber and mineral region, and connects at Gadsden with the Anniston & Cincinnati R. R. and the Rome & Decatur R. R., and at Huntsville with the Memphis & Charleston R. R. and the Elora branch of the Louisville & Nashville R. R.

A BILL to bridge the Hudson river and connect New York City with New Jersey has been introduced in the New York Legislature by Judge GREENE of New Jersey. The New York terminus of the bridge is to be between 10th and 181st Sts., the exact location to be determined by a Commission appointed by the Governor for this and other purposes. The proposed bridge has but one pier in the river, with spans of not less than 1.300 ft. each. No portion of the bridge is to be less than 130 ft. above high water, and a space of 500 ft. on each span shall be 136 ft. above high water. The pier is to be lighted from sunset to sunrise and be provided with a fog horn. No company is to be incorporated by the passage of this bill, but the Commissioners to be appointed shall give two weeks notice in the public press of the opening of subscription books.

THERE was a narrow escape from a bad accident on the Pennsylvania Railroad, just out of Jersey City, on the 9th inst., directly in front of a block signal station. A passenger train ran into the rear of a freight which had been stopped by a third train ahead. There may have been special circumstances to excuse the accident, but under whatever circumstances it is not a good card for the efficiency of the block system that such an event could happen so near to the terminus of so important a line.

A BAD wreck at Rockingham, Vt., this week, in which two were killed and a dozen or more injured, seems to have been traced directly to a defect in an embankment made 39 years ago, a stratum of quicksand having been used in making it. It is stated that a number of somewhat similar slides and washouts have occurred in past years on the same road. We have frequently known of banks slipping within 4 or 5 years after construction, but that an embankment 40 years old should slip in this way is somewhat of a novelty, and indicates the importance of caution in disposing bad material in banks. The tendency to make them by side filling is strong, but much to be regretted.

This was the most serious railway accident of the week. Others were: On April 5 a passenger train on the Fernandina & Jacksonville line of the Florida Railway & Navigation Co., ran into an open draw at the Amelia Island bridge. The bridge-keeper had the danger flags out, but the train ran right on at a speed of about 6 miles an hour; another instance of deliberate disregard of signals. The engine and a flat car went into the water. The engineer was fatally injured.——On April 6 the boiler of a Mogul freight engine burst at Craigville, N. Y., on the New York, Lake Erie & Western Railroad. The train was standing still. The boiler was hurled several hundred feet away. Three men were killed.——On April 9 a stock train on the New York, Lake Erie & Western Railroad was derailed by a cow near Carrollton, N. Y. Both engines were derailed and 10 cars damaged. One man was killed and 4 injured.

THE following bridge and trestle accidents are reported: On April 7 a bridge was washed away at Hadley, Mass.; loss $5,000.——At West Stockbridge, Mass., the Main St. bridge, 2 foot bridges, the abutments of another bridge and the abutments of the Housatonic Railroad bridge have been carried away. ——The iron bridge over New river, at Fayette Station, W. Va., built 2 years ago at a cost of $18,000 was "blown down and destroyed" April 5. ——The South Carolina Railway bridge over the Edisto river was burnt April 5. It was 17 years old, but in good condition.——The center pier of the Coosa river drawbridge on the Anniston & Cincinnati Railway at Gadsden, Ala., has been moved 9 ft. out of place by the recent freshets.—— At Bay City, Mich., the draw of the 23d St. bridge, which was being taken down to make way for a new draw, gave way and fell down.——It is reported that nearly all the bridges in Faribault Co., Minn., have been washed away.——At Sheboygan, Wis., the bridge of the Milwaukee, Lake Shore & Western Railway has been damaged by the flood.——An iron bridge at Rock Falls, Ia., and a railway bridge at Des Moines, Ia., have been wrecked by floods.

THE charter of incorporation of the Baltimore & Ohio Employès' Relief Association has been taken away by the Maryland Legislature. The Knights of Labor have been fighting the organization for some time and the company has finally acquiesced in the movement to take away the corporate character of the association. The affairs of the company are to be wound up within a year; but in its place there will be established a mutual benefit and relief association which will carry on the work of the old corporation and be free from the interference of the legislature.

If we are rightly informed, a large proportion of the employés are heartily in sympathy with the work of the association and have no desire that its beneficial aid should be withdrawn. The principal opposition to it has been based on the ground that it tended to hinder any employé leaving the service of the company, as in that case he was obliged to lose what he had invested in the relief fund. The compulsory feature was also objected to, and with much reason, for it is not in accordance with American ideas of personal liberty. A mutual benefit organization should offer such advantages to its participants that there would be no need of compulsion to fill it with members. Perhaps the great reduction in casualties which will attend the use of automatic freight brakes and couplers and the consequent reduction of assessments will add largely to the popularity of these relief associations, though it will take away much of their present necessity.

THE Nicaragua Canal surveys are progressing very favorably. Advices up to March 23 indicate that most of the party are in good health, and that the question of labor supply will be a very much less serious one than at Panama. Very unusual speculative activity has sprung up in Greytown, based upon the prospective canal construction, which we trust will not be disappointed.

THE great Burlington strike seems to have practically collapsed, with the abandonment of the effort to boycott C. B. & Q. cars. The prompt abandonment of this effort at illegal and indefensible obstruction is one of the most significant signs of progress towards the more rational solution of labor difficulties which has occurred, and is practically a direct result of the interposition of National authority to regulate such matters through the Inter-State Commerce Law.

WE have received statements which seem to show that the C. B. & Q. was paying its men fully as much as neighboring roads before the strike, but cannot analyze them this week.

FLOODS and washouts continue to be reported in considerable numbers. The Missouri river has overflowed in Iowa, doing considerable damage. The village of Rock Falls, Ia., on Shell Rock river, has been completely inundated. In Minnesota a number of rivers have overflowed. —— Landslides occurred on the Chesapeake & Ohio canal, near Cumberland, Md., and on the Chicago, Milwaukee & St. Paul Railway, near Lanesboro, Minn.—— Washouts have occurred on a number of roads in the Northwest, also in the South, and one near Attica, N. Y., on the Erie. At the last, 12 freight cars were ditched.——A freight train is reported to have been blown from the track at Sleeths, Ind. April 5.——Dams have been wrecked at Baraboo, Wis.; Amsterdam, N. Y., and West Stockbridge, Mass.——A cyclone caused considerable damage at Sioux City, Ia., April 5.

THE address of Mr. L. E. COOLEY, President of the Executive Board of the Council of Engineering Societies on Natural Public Works, was incorrectly given last week as 17 instead of 171 La Salle St. Chicago, Ill. Mr. COOLEY writes us that he has in consequence been considerably annoyed by misdirected mail and requests us to correct the error.

MESSRS. ROSS & SANFORD, contractors, are using a "Cram" steam hammer pile-driver in driving the piles for the new pier which they are building at the foot of Market street, New York, under contract with the Department of Docks. This is the first time that this kind of pile-driver has been used in work done for the Department of Docks, and so far as we know, the pile-driver referred to is the first one of the steam-hammer type that has ever been used in this vicinity, it having recently been employed on some dock work in New Jersey. It is giving very satisfactory results, and we hope in a future issue to be able to give a full account of its operations.

THE report of Chief Engineer GERSCKE, of Chicago, who recently investigated the losses sustained by that city through mismanagement of the North Side pumping works, on the West Side works, shows that a very bad condition of affairs has prevailed there likewise for a number of years. As to the manner in which tests have been made to regulate the supply of coal for the use of the two pumping works, the report alleges that a loss of at least $30,000 a year has been sustained by the city in the item of coal alone at the West Side, and $50,000 at the North Side works. In connection with the now admitted fact that the South Side engines had been pumping air at great expense for years, this makes a rather bad showing for the administration of the Chicago water works.

According to tables in the *Street Railway Journal*, the enormous aggregate of 1,198 miles of new street railway track was laid in the United States and Canada in 1887, and 1,112 miles are projected for 1888, at an estimate cost of $9,738,000. The total estimated cost of proposed improvements in existing lines is $15,331,000, a large part which is due to the substitution of cable and electric plant in place of horse-power.

THE last issue of *Engineering* again illustrates the strong tendency in England to adopt the distinctive features of the American locomotive. Another new compound express locomotive, for the Northeastern railway, has both the American truck and cab, horizontal cylinders, and general resemblance to the American type in various other details. It lacks, however, equalizing levers, which have been quite generally introduced on other English locomotives, and does not use the link valve gear.

THE Myrtle Ave. section of the Union Elevated Railway, Brooklyn, N. Y., was opened for traffic April 10; at present the trains only run to Adams St., near the City Hall, but in a few days the line will be in operation along Adams St. to the Brooklyn bridge.——The Fulton St. line of the Kings County Elevated Railway will also be opened shortly, and will probably start with as heavy a traffic as it can well manage. Various entirely new projects are also going through the preliminaries to construction. Altogether rapid transit in Brooklyn is evidently to be a "big thing."

Slide Moment Diagram for Computing Bridge Strains.*

The "Slide Moment Diagram" described in the following article, we are informed by the author, has been in use in the Baltimore & Ohio office for the past three years, and is considered the best known method of finding shears and moments in bridge trusses. In practical use it is claimed to be superior to the method by "Moment Polygons," described in ENGINEERING NEWS of March 10, and its construction is so simple that a calculating engineer in a bridge office can get up such a complete diagram for a new engine in a couple of hours.

Of the different methods used for obtaining the maximum strains in a bridge, the one based on the assumption of a uniformly distributed load has a decided preference. Not only is the drudgery of calculating lessened, or in fact, by using Thacher's Calculating Instrument, entirely done away with, but it is argued that when the load is properly assumed, the results are such close approximations to those obtained by placing the engine, that, except in rare cases, it is likely one method will satisfy the actual conditions as well as the other.

The usual load specification for railroad bridges has been two typical Consolidation engines followed by a certain weight per lineal foot; but during the last few years the heavy Consolidation is accompanied by Mogul and passenger types, and the calculator must find which engine will give maximum strains in each particular member.

Even to the adept, aided by a long experience, tables, slide rules and every facility for hurrying on the work, this is very laborious, while to the occasional calculator without such aids, the figuring of one simple Pratt truss represents such an amount of labor and waste of mental energy, that *laborious* and *undesirable* very inadequately express his disapprobation.

No wonder then that so many able engineers engaged exclusively in designing bridges, in their natural desire to simplify tasks, advocate uniform loads, and no wonder that the general engineer, who only occasionally makes such designs, cries down the wheel loads and asks wherefore such excessive refinements when there is an ample factor allowed for ignorance and uncertainty—since most of these specified engines are merely types of what exist on paper only, why not specify at once a uniform load or a uniform load with locomotive excess at head?

When some expert divulges a simple modification of uniform load which will give identically the same strains as produced by the engine in question, then we can cast aside our moment tables and diagrams. But no uniform load alone can be assumed which will give correct strains in both web and chords. True, in some members the strains will be *about* correct, but in others there is a wide difference.

The author cannot altogether agree with the advocates of the simpler method, when they state that a uniform load which gives the same center moment in spans up to about 65 ft. and same end shear when above this, will, with the exception of a few cases of double intersection trusses, gives results so nearly identical to those produced by wheel loads, as to amount to no essential difference in the distribution of material. Of course the whole question hinges on *what* amount is considered no essential difference, the advocates of one method being very liberal, while those of the other are very exacting. The line should be drawn somewhere. In the Baltimore & Ohio office a greater variation from the wheel load than $\frac{1}{10}$ sq. in. of section, or about 2,000 lbs. strain is considered incorrect, and sections must be increased when short more than this amount. As we have found in many cases much greater differences, we have come to the conclusion that uniform loads, except for plate girders and other special cases, are not reliable when accuracy is desirable. It stands to reason that, when an engine is placed on a particular span, say of seven panels, and the uniform load deduced which will give the same end shear as the engine, this end shear answers only for the span in question of seven panels, and will not give correct end shear if applied to the same span with either six or eight panels. Further, when the uniform load is sought, the span is considered without panels and the engine is placed without regard to them. From this it is also evident that when the span is divided into panels the case is entirely different, and results differently, even for the end shear, which from the assumption is supposed to be correct.

The author does not say it is impossible to find a uniform load which will give such close results as to allow the most exacting no chance for complaint, but such loads must have an excess at the head, and this excess will have to be some function of span, number of panels, and uniform load. Most railroad engineers check over the strain sheets presented by competing bridge companies, and when careful men, they use the wheel load method. By this is meant the placing of the engine so as to give maximum shears or moments, therefore, it is not absolutely essential for the bridge companies to go through with the same labor, inasmuch as the simpler method will give an estimate of *weight* and *cost* practically the same, the excess in some members balancing the scantage in others, while any difference in strain can be easily rectified. Railroad engineers prefer the wheel load method, not because it is so laborious and they have plenty of spare time, but because it is decidedly more scientific, the results being those sought, *i. e.*, the maximum strains produced by typical engines, and it is a *certain* check on the accuracy of assumed loads, used by the parties making bids.

When there are several engines to provide for, it will be found very convenient to tabulate the maximum panel weight for different lengths, also maximum center moments for different spans, then once for all select the greatest of the different results. With the exception of a very few cases it will be found that the Consolidation type produces the greatest strains.

The next thing is to consider the most convenient and expeditious manner of applying the engine wheel loads. Three ways are offered:

1. BY MOMENT TABLES, which give summation of moments and weights from wheel to wheel, the distance center to center of wheels, and distance of each succeeding wheel from first.

2. BY A TRACING DIAGRAM, which is a sketch of the engine on tracing cloth, having summation of weights, moments and distances written at their proper places.

3. BY A SLIDE MOMENT DIAGRAM, which has moments, etc., arranged in a similar manner to the above tracing, but attached to the movable part of a slide rule.

These different ways will be considered in their respective order.

To make out a table of moments for two engines coupled and followed by a uniform load, is not the long and tedious task that appears upon the first glance. It is a problem; and like most problems, there is a simpler solution than that which first presents itself, and which will be clear with a moment's consideration before pitching directly *in*

Fig. 2.

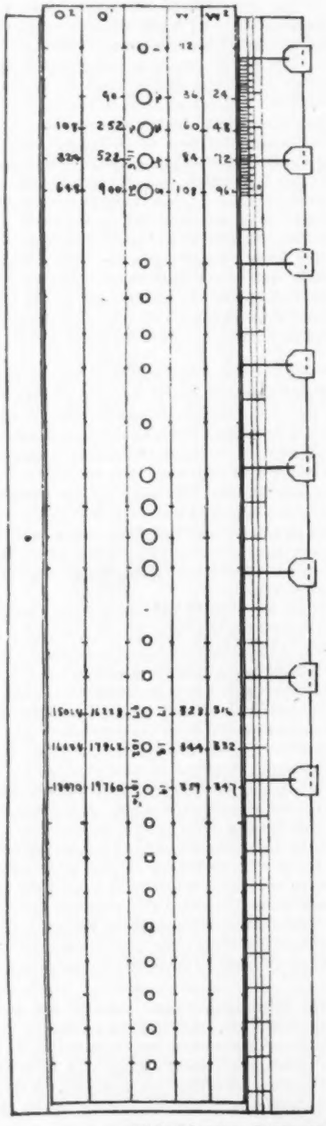
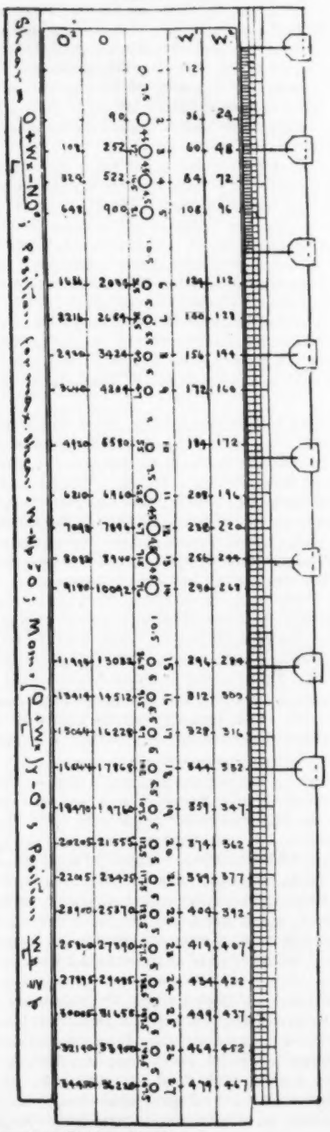


Fig. 1.



Slide Moment Diagram for Computing Bridge Strains.

*Abstracted chiefly from a paper by J. E. GREINER, C.E., Asst. to Engineer of Bridges and Tests, Baltimore & Ohio Railroad. Proceedings of the Engineers' Society of Western Pennsylvania.

medias res. It will only be necessary to indicate this process, because to the engineers who use such tables a discussion would be uninteresting.

The loading used in the following illustrations is that used by the Baltimore & Ohio Railroad, one year ago, viz.: two 86-ton typical Consolidation engines followed by 3,000 lbs. per ft.

Moment Table for two B. & O. 86-ton Engines and 3000 lbs. per ft. for one truss single track.

I.	II.	III.	IV.	V.	VI.	VII.
No. of Wheels on Bridge.	Distance from First.	Distance between Wheels	Weight on each Wheel.	Summation of Weights.	Moments due to Summation of weights by dist. to following Wheel	Summation of Moments.
1	0		6000	6000		
2	7.5	7.5	12000	18000	45000	45000
3	12	4.5	12000	30000	81000	126000
4	16.5	4.5	12000	42000	135000	261000
5	21	4.5	12000	54000	189000	450000
6	31.5	10.5	8000	62000	567000	1017000
7	36.5	5	8000	70000	310000	1327000
8	42	5.5	8000	78000	385000	1712000
9	47	5	8000	86000	390000	2102000
10	55	8	6000	92000	688000	2790000
11	62.5	7.5	12000	104000	690000	3480000
12	67	4.5	12000	116000	468000	3948000
13	71.5	4.5	12000	128000	522000	4470000
14	76	4.5	12000	140000	576000	5046000
15	81.5	10.5	8000	148000	1470000	6516000
16	91.5	5	8000	156000	740000	7256000
17	97	5.5	8000	164000	858000	8114000
18	102	5	8000	172000	820000	8934000
19	107.5	5.5	7500	179500	946000	9880000
					9880000	

From the above table it will be seen that very little labor is required in tabulating the moments for any length of span, the only multiplication necessary being the product of summation of weights shown in column V. by distance to following wheel, column III.; results shown in column VI. Column VII., as its title indicates, is the sum of moments found in column VI. For instance, to find summation of moments about fourth wheel, add up the moments in column VI., including this wheel, and result is 261,000 in column VII., or moment about fourth wheel equals moment about third, 126,000 plus 135,000 in column VI. equals 261,000 as before.

Application of Moment Tables—

W = total weight on bridge,
N = number of panels,
p = sum of weights in advance of point where shear is required.
y = distance from front end of bridge to panel point where moment is required.
L = length of span.

Then position for

Maximum shear occurs when $W - Np \geq 0$.

" Mom. " " $\frac{Wy}{L} - p \geq 0$.

If O = sum of moment about last wheel on bridge,
O^o = " " " point where shear or moment is required,
X = distance from last wheel to rear end of bridge,
K = length of panel,

Then

$$\text{Shear at any point} = \frac{O + Wx - O^o}{L} = \frac{O}{K} + \frac{W - NO^o}{L} \quad (1)$$

$$\text{Moments at any point} = \frac{(O + Wx)\,y - O^o}{L} \quad (2)$$

Take now a practical example to illustrate the adaptation of the table to the above formulæ. Draw a diagram of a Pratt truss. Let N, the number of panels = 7. Let L, length of span = 105 ft. Then k, the length of one panel = 15 ft. Required the maximum shear in the inclined end post. Begin at either end and write down the sum of the different panel lengths at each panel point; then proceed to find position for maximum shear as follows:

If the third wheel be placed at the end of first panel the distance from the head of the engine to the rear end of the bridge will be 90 + 12 = 102 ft. Look along column II. for the next smaller distance, which is 97, corresponding to seventeenth wheel. Opposite seventeenth wheel in column V. find W = 164,000, and opposite second wheel in same column, p = 18,000; hence:

$$W - Np = 164000 - 7 \times 18000 = +38000$$

If fourth wheel be placed at the end of the first panel, the first will leave the bridge. Distance from head of train to end of span = 90 + 16.5 ft = 106.5 ft. From column II. find that 102 ft. is the distance from head to last wheel on bridge (the 18th). Opposite 18 find column V., W = 172000, but since first wheel is off, W = 172000 — 6000 = 166000. In like manner weight in column V., opposite third wheel, must be diminished by 6000, and we have p = 30000 — 6000 = 24000; hence,

$$W - Np = 166000 - 7 \times 24000 = -2000$$

From the conditions for position of engine for maximum shear the value $W - Np$ must never be negative; therefore, if no wheel makes this quantity equal to zero, the nearest positive result determines the position. Hence, third wheel at the end of the first panel will give the maximum end shear on the bridge.

Having found the position proceed at once to find shear by applying formula (1). With third wheel at the end of first panel point the distance from head of train to end of span was found to be 102 ft., and that the seventeenth wheel was last on the bridge; hence,

In column VII. opposite 17, O = 8114000
" V. " 17, W = 164000
" VII. " 3, O^o = 126000
$X = 102 - 97 = 5$

Therefore,

$$\frac{O + Wx - NO^o}{L} = \frac{8114000 + 16400 \times 5 - 7 \times 126000}{105} = 76686,$$

which is the maximum shear in the end post.

It will be noticed that in this particular case the summation of moments at end of span could have been taken directly opposite the 19th wheel, which is over the end of span, thereby saving the labor of obtaining the value of Wx; but in order to make this example more general, no attention was paid to the fact.

After what has preceded, the formula for moments requires no explanation, since the application is similar. It might be well to observe, however, that "y" will always be one or more panel lengths, and, therefore $\frac{y}{L}$ (in cases where panels are of equal lengths) can be simplified by making $L = N$ and y = the number of the point in question from head of span.

THE TRACING DIAGRAM, as mentioned before, is simply a scale sketch of the engine wheels made on tracing cloth, having the distances, weights and moments, as shown in columns I., II., III., V., VII., written at their proper places over wheels. It possesses a slight advantage over the *tabulated* moments for obvious reasons, but it is awkward to handle, and requires for its advantageous use a sketch of the truss drawn to same scale as diagram, so that by placing the latter on the truss the different positions can be seen at once. It lessens the chance of error in taking out the weights and moments; also often enables the expert to judge accurately in regard to proper positions without the necessary preliminary calculations given in description of moment tables. The necessity of drawing the truss to scale, besides having two extra loose sheets on the desk in addition to the papers, specifications, notes and other loose articles required while estimating, render this appliance objectionable, and engineers would rather refer to moment tables than hunt up this tracing and corresponding sketch, which will be often mislaid or covered up.

THE SLIDE DIAGRAM.—It was for the purpose of avoiding scale drawings, besides having the moments, etc., in such shape as not to be easily mislaid, that the advisability of attaching a tracing diagram to the movable part of a slide rule was suggested, and first put into practice in the consulting engineer's office of the Baltimore & Ohio Railroad.

The stationary part of the rule is divided into feet with as many smaller divisions as convenient, and is provided with a number of adjustable clamps for marking off the panel points. These clamps are made of brass, having a thin steel pointer attached. They are easily moved to any distance and then made fast by thumb-screws. The slide part represents the engine with all its distances, moments, etc., as explained for the moment table, but for convenience having two additional columns, one for sum of weights, the other the sum of moments, from second wheel. The drawing shows this diagram full size up to 150 ft. span. Column W^1 and W^2 are summation of weights from first and second wheel respectively. Columns O^1 and O^2 represent the summation of moments. O^2 and W^2 are to be used only in such cases where the maximum shears and moments result when first wheel is off the bridge. These two columns lessen labor somewhat, since, if omitted, subtraction will have to be made, as shown for moment tables with fourth wheel at end of first panel. Weights and moments are expressed in 1,000 lbs., the last three figures being omitted, and are given for total engine or for one truss double track.

The rule is made of well seasoned hard wood. The diagram and scale being first made on tracing cloth are then blue-printed and the blue-print fastened to the wood by means of varnish. The scale should not be separated from the diagram until the varnish becomes thoroughly dry, or there is danger of the two shrinking unequally, and consequently there would be uncertainty in using the scale.

The use and convenience of this appliance will be illustrated by same example as before. Adjust clamps so as to represent panels of 15 ft. then move slide until the third wheel is at the end of the first panel (see Fig. 1). This position shows seventeenth wheel the last on bridge, and there is seen directly that W^1 = 164,000, the total weight on bridge, p, the weight over second wheel is 18,000, hence, as before—

$$W - Np = 164000 - 7 \times 18000 = +38000^*$$

which gives the position for maximum shear in the end post.

If fourth wheel be placed at the end of the first panel (see Fig. 2), the first will leave the span, hence the value of $W - Np$ taken from column W^2 is,

$$166000 - 24000 \times 7 = -2000.$$

Place the third wheel at the end of the first panel and proceed to find shear by applying formula (1). The distance X = 5 ft. as well as all the other values of the formula, are read off directly. Hence—

$$\frac{O^1 + W^1x - NO^o}{L} = \frac{8114000 + 164000 \times 5 - 7 \times 126000}{1} = 7668$$

which is the maximum shear in the end post.

By comparing the direct way of this method with the roundabout moment tables or clumsy tracing, its superiority becomes at once apparent, so that little need be said in order to unfold its many advantages. The position for maximum moment, and the moments themselves, can be obtained just as easily as the foregoing shears; therefore any further applications in the present paper would be superfluous.

The points in favor of this method can be briefly enumerated as follows:

1. Simplicity of application.
2. Convenient size, taking up small space on desk and always ready for use.
3. Requires no preliminary drawing, but shows at once position of train on the bridge, thereby reducing mental labor to a minimum.
4. The engine remains in the position until moved.
5. Lessens chances of error.

In conclusion, it might be mentioned that the "Slide Diagram Method of Moments" is the most practicable manner of figuring strains when accuracy is required, and the engineer after once using such an appliance as here described will no more willingly return to tables and tracings, than he would again prefer the exercise of multiplication and division after having once become familiar with Mr. THACHER'S valuable calculating instrument.

COST OF STREET CLEANING IN VIENNA.—During last December, about $36,000 were spent to clean the streets of Vienna; about $15,000 being for wages covering 310 working days of chief inspectors, 434 days of inspectors, 2,812 days of foremen, 26,206 days of laborers. There were removed 5,790 loads of dirt, costing $2,100, and 9,208 loads of snow, costing $3,600. At this rate, which is for a very expensive month, the total cost per year would be only $432,000.

AT Bournemouth, Eng., the streets are sprinkled very successfully with salt water, which is conducted from the ocean to certain hydrants. The salt water is found particularly advantageous for macadamized road as it seems to make the immediate surface more compact. It is further found that the surface holds the moisture about three times as long as when watered with fresh water.

*These results are for single track, or ½ of weights and moments given on figures "1" and "2."

The Carbon Iron Co.'s Direct Process.

In our extract from Mr. ALFRED E. HUNT's paper* on "Modern Improvements of Open Hearth Steel Practice," we stated as to the steel produced with Castle pig iron and Carbon Iron Company sponge balls made from Minnesota "Y" ore, "reckoning the scrap at 4 per cent. the cost figures out higher than the market rates at present, for making a good enough grade of structural material to answer usual engineering requirements." We learn that this statement, which was intended to be a correct condensation of the paper, does not correspond with what was intended, and that the cost of the steel ingots at the figures given are not higher than the market rates at present for that grade of ingots for structural steel, and in fact, it is claimed that a very good margin of profit can be made using steel of the mixture given for structural material. The statement intended was rather that the grade of material was of a higher cost stock than was needed to be used for making a good structural steel, and that instead of the use of Castle pig iron a good Bessemer metal could be used, costing at least $6. per ton less, and the Minnesota "Y" ore could be replaced with a cheaper ore, making the cost per ton of the sponge balls at least $2 per ton less, making the cost of structural steel ingots at least $6 per ton less than with the mixture of Castle pig iron and Minnesota "Y" ore, which cost will be considerably less than that of making ordinary open-hearth steel, and very near to the price of ordinary Bessemer steel ingots, of phosphorus below 0.08 per cent. On this basis our previous statements were somewhat misleading as to the very important item of the cost of the Carbon Iron Co. product made into structural steel.

We make this correction with pleasure, and believe the figures now given to be correct, although we assume no responsibility for them. The proper way in descriptions of all such new processes is to put out the actual figures at once and allow everyone to judge for themselves, since those most directly interested and who are most likely to be business rivals can always ascertain the figures easily enough by a little investigation. This course the company has not seen fit to adopt, from mistaken ideas of expediency, and some misunderstandings are natural. Nevertheless, the process itself remains just as good, and is certainly one of the highest interest and promise.

American and Foreign Exports and Imports.

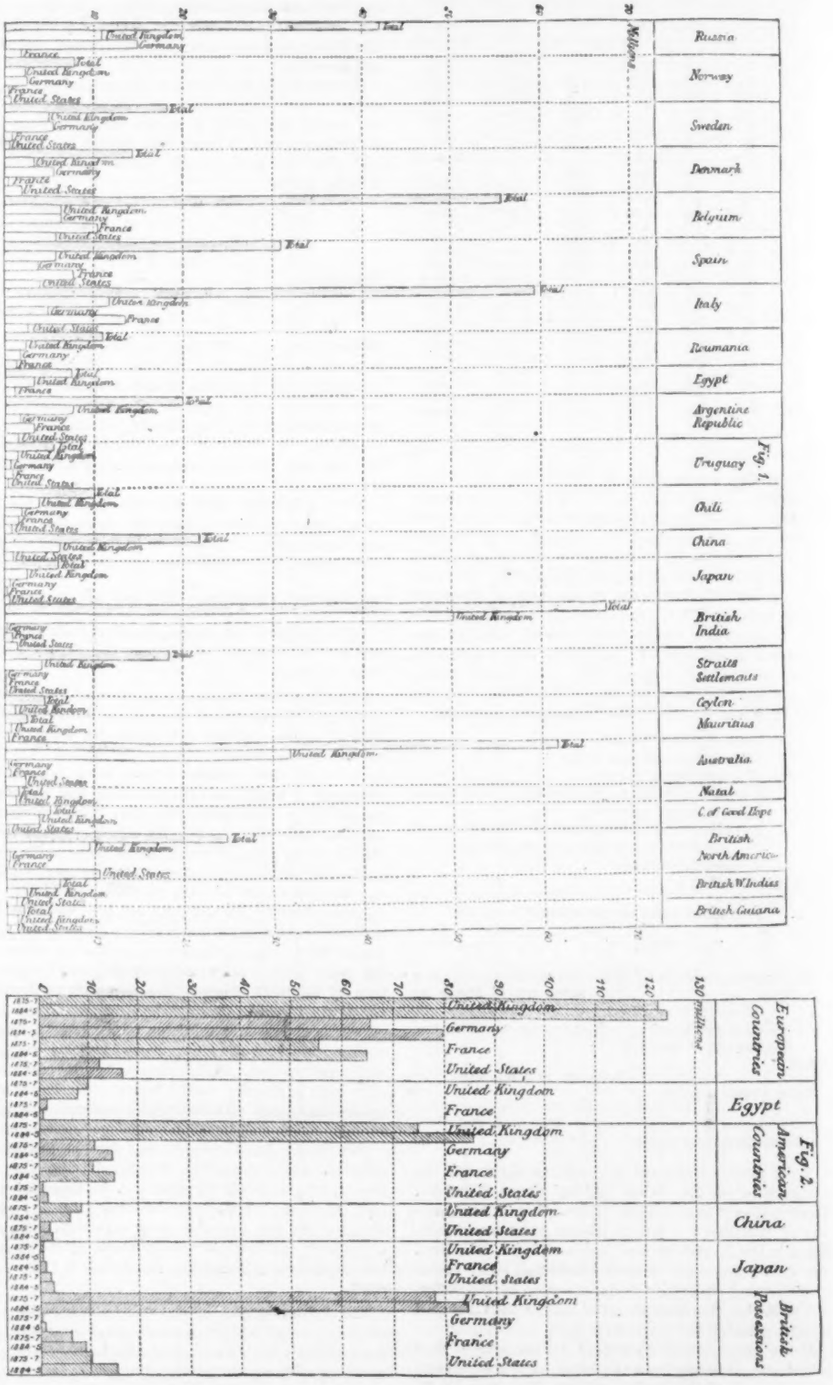
We reproduce herewith from the English *Board of Trade Journal* two diagrams prepared by Mr. R. GRIFFIN to accompany an article on "Competition with English Foreign Trade," which show admirably well how American, English, French and German trade stands with all countries, and so tell a lesson which is more salutary than pleasing to Americans.

The first diagram shows the exports from the United Kingdom, Germany, France and the United States to the various single countries whose names are given at the head of the diagram. For each receiving country there is a space subdivided into the stippled column to show total imports from the four exporting countries, and other columns to show what part of these each country contributes. The values given are in *millions of pounds sterling.* From this diagram it appears that Germany leads in exports to northern, and France to southern Europe, while England presses close behind in each case. Leaving Europe, England is decidedly ahead in the amount exported; naturally, it carries 75 per cent. of British India's total imports, and 52 per cent. of Australia's. A glance at the diagram shows the United States accredited with no trade with Russia, Roumania, Egypt, Ceylon, Mauritius, or Natal. Doubtless there is a little trade with these countries, but it is not appreciable on a diagram of this scale. It is only in British North America that the United States ranks first, and even here it has but two-fifths of the total import volume. With British India, the United States ranks next to England, but this signifies little when we consider that England has 75 per cent. of India's import trade. Therefore in the carrying of no country's imports save British North America does the United States have even an approach to a fair divide.

*ENGINEERING NEWS, March 24, 1888.

But in this connection it should be remembered for our comfort that the United States has an internal commerce far greater than that of any nation. Balancing our internal commerce by water, along our seaboards and by our great lakes, rivers and canals, against the total internal commerce of England, France or Germany, which it is approximately fair to do, we have left our internal commerce by rail, the greater portion of which at least is only comparable with the export trade of other and smaller countries. We carry by rail 500,000,000 tons yearly, which, at an average valuation of $60 a ton, and it probably reaches that, is worth $3,000,000,000, or £600,000,000 sterling. England's total export trade is about £300,000,000 sterling, or one half our internal commerce by rail. Therefore, as a commercial nation, if it were possible to compare trade on a fair basis, it would undoubtedly be found that we lead the world by far.

The second diagram is even more interesting, showing, as it does, the comparative bulk of trade which each of the four countries had with the various great divisions of the earth in the two periods, 1873-7 and 1884-5. The United States cuts a pretty small figure here, and we fear is likely to do so for some time to come. Should any large part of it ever fall into our hands, in addition to our present internal commerce, the business of the United States would become so enormous that in comparison with it that of the largest European country would be insignificant.



Diagrams of the Export and Import Trade of the Leading Commercial Nations.

ON account of the space taken up by Mr. GOODMAN's article on Friction, we are obliged to postpone to a latter issue our illustrations and descriptions of the Standard Pile and Trestle Bridges on the Chicago, Burlington & Northern Railroad.

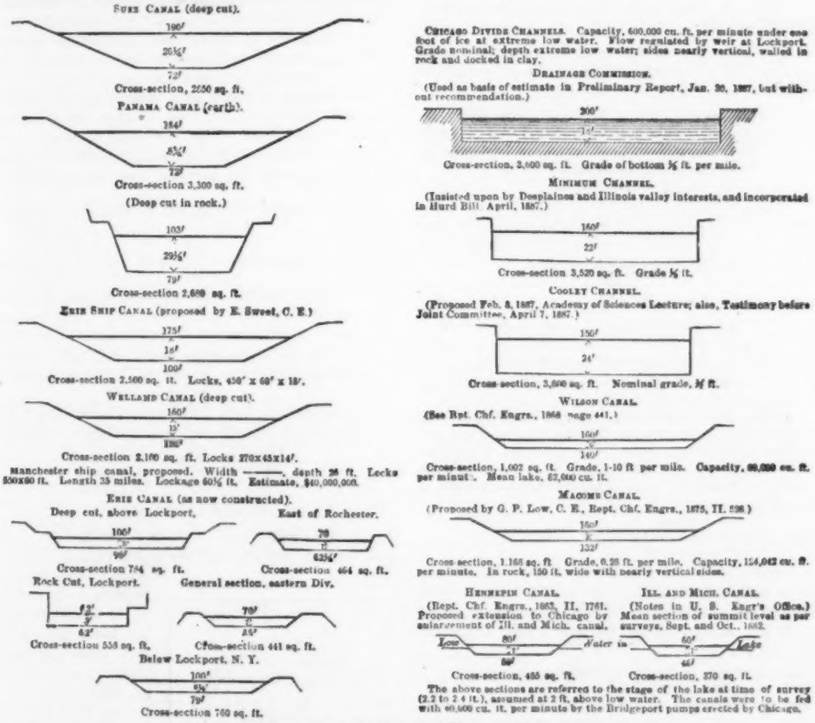
The Lakes and Gulf Waterway.

The committee on main drainage of the Citizens' Association of Chicago, composed of DANIEL L. SHOREY, HARVEY B. HURD and EDWIN LEE BROWN, have submitted to the Association their report as prepared for them by L. E. COOLEY, C. E. The object of the report is "to show the practicability of restoring the ancient outlet of the great lakes, by opening a channel across the Chicago divide," thus giving a great water-way to the Gulf of Mexico. A similar water-way to the Atlantic is discussed, and the relations of the scheme to the drainage of Chicago, and to the commercial interests of the whole country are set forth. A large part of the matter has been published in substance in this journal, but now it is all given in connected form. The route which meets with most favor is from Lake Michigan through the Chicago river, Mud Lake, the Desplaines and Illinois rivers to La Salle, the head of navigation on the Illinois river, and thence to the Gulf through the Illinois and Mississippi rivers. The contour of this route is described as follows:

"From Chicago to Romeo, 27 miles, the surface of the ground is about 6 ft. above mean level of Lake Michigan. From Romeo to Lake Joliet, 10 miles, there is a descent of 77 ft. below lake level. From Lake Joliet to La Salle, 60 miles, is a fall of 70 ft. The total distance from Lake Michigan to La Salle is 100 miles. Total fall from Chicago to La Salle 146.6 ft. From La Salle to the mouth of the Illinois, 225 miles, there is a fall of 27 ft."

From Chicago to Lake Joliet, in the Desplaines river, it is proposed to make the channel 160 ft. wide and 22 ft. deep below the lake surface. From Lake Joliet to La Salle slack-water, locks, dams and improvements would be made, which would give a navigable channel from 300 to 600 ft. wide, and not less than 14 ft. deep. From La Salle to the Mississippi, at low water a depth of 10 ft. on bars, and ultimately 14 ft. This channel is to carry 600,000 cu. ft. of water per minute, which will make the Illinois a "capacious and vigorous stream, purifying itself," instead of the stagnant, unhealthy and unnavigable river which it now is in dry weather. It will also dilute the sewage now introduced into the river from Chicago and other towns and cities along the Desplaines and Illinois rivers, and have a beneficial effect upon the Mississippi river.

Besides these claims, it is stated that a large and unvarying amount of water power will be developed between Lockport and La Salle, making this section a great manufacturing center. In addition to this, the proposed waterway will constitute 113 miles of the projected Hennepin canal, or about two-thirds of its entire length.


SUEZ CANAL (deep cut).
Cross-section, 2250 sq. ft.
PANAMA CANAL (earth).
Cross-section 3,300 sq. ft.
(Deep cut in rock.)
Cross-section 2,689 sq. ft.
ERIE SHIP CANAL (proposed by E. Sweet, C. E.)
Cross-section 2,500 sq. ft. Locks, 450' x 60' x 18'.
WELLAND CANAL (deep cut).
Cross-section 2,100 sq. ft. Locks 270'x45'x14'.
Manchester ship canal, proposed. Width ——, depth 26 ft. Locks 500x60 ft. Length 35 miles. Lockage 60½ ft. Estimate, $40,000,000.
ERIE CANAL (as now constructed).
Deep cut, above Lockport.
Cross-section 784 sq. ft.
East of Rochester.
Cross-section 464 sq. ft.
Rock Cut, Lockport.
Cross-section 558 sq. ft.
General section, eastern Div.
Cross-section 441 sq. ft.
Below Lockport, N. Y.
Cross-section 760 sq. ft.
CHICAGO DIVERSION CHANNELS. Capacity, 600,000 cu. ft. per minute under one foot of ice at extreme low water. Flow regulated by weir at Lockport. Grade nominal; depth extreme low water; sides nearly vertical, walled in rock and docked in clay.
DRAINAGE COMMISSION.
(Used as basis of estimate in Preliminary Report, Jan. 30, 1887, but without recommendation.)
Cross-section, 2,600 sq. ft. Grade of bottom ½ ft. per mile.
MINIMUM CHANNEL.
(Insisted upon by Desplaines and Illinois valley interests, and incorporated in Hurd Bill April, 1887.)
Cross-section 3,520 sq. ft. Grade ½ ft.
COOLEY CHANNEL.
(Proposed Feb. 8, 1887, Academy of Sciences Lecture; also, Testimony before Joint Committee, April 7, 1887.)
Cross-section, 3,600 sq. ft. Nominal grade, ½ ft.
WILSON CANAL.
(See Rpt. Chf. Engrs., 1868 page 441.)
Cross-section, 1,002 sq. ft. Grade, 1-10 ft per mile. Capacity, 60,000 cu. ft. per minute. Mean lake, 67,000 cu. ft.
MACOMB CANAL.
(Proposed by G. P. Low, C. E., Rept. Chf. Engrs., 1875, II. 526.)
Cross-section, 1,166 sq. ft. Grade, 0.28 ft. per mile. Capacity, 154,042 cu. ft. per minute. In rock, 150 ft. wide with nearly vertical sides.
HENNEPIN CANAL.
(Rept. Chf. Engrs., 1885, II. 1761. Proposed extension to Chicago by enlargement of Ill. and Mich. canal.
Cross-section, 455 sq. ft.
ILL. AND MICH. CANAL.
(Notes in U. S. Engr's Office.) Mean section of summit level as per surveys, Sept. and Oct., 1882.
Low Water in Lake
Cross-section, 370 sq. ft.
The above sections are referred to the stage of the lake at time of survey (2.2 to 2.4 ft.), assumed at 2 ft. above low water. The canals were to be fed with 60,000 cu. ft. per minute by the Bridgeport pumps erected by Chicago.

Comparative Cross-Sections of Various Canals.

Having related this, the report calls attention to the fact that Chicago now discharges its sewage into the Chicago river, and pumps it from this into the Illinois and Michigan canal, from which it flows into the Desplaines and Illinois rivers. But the capacity of these means of disposal is only 60,000 cu. ft. per minute, not enough for the disposal and dilution of sewage from 800,000 people. It is claimed that the proposed channel, carrying 600,000 cu. ft. per minute, will dispose of the sewage of 2,500,000 people.

By uniting the commercial waterway and the sewage channel, two great ends will be served and each brought about much more cheaply and quickly than could either one alone. What Chicago proposes and asks, in brief, is as follows: "She will, at her own expense, restore the ancient channel connection between the lakes and the rivers, the United States being only asked to utilize the great water way thus created for the purposes of commerce and national defense," and for the first step, Congress is requested to have made a survey, location, plans and estimates with a view to this co-operation. The Illinois State Legislature is asked to give such legislation as will enable Chicago to do at its own expense its part of the work.

The history of previous projects, legislation, surveys and work which has been done to effect the construction of a lake and gulf water-way has been somewhat fully given in our issue of Feb. 18, under the head of "Connecting the Mississippi and the Upper Lakes," so that a further account is unnecessary. Chicago has been led to the consideration of this latest project by the growing need of better means of sewage disposal, which need is now well nigh imperative. All measures which have heretofore been taken have been rendered inadequate by the rapid growth of the city, and by the natural difficulties to be overcome. The cost to Chicago of its part of the proposed work is estimated to be about $26,000,000. This includes the diversion of flood waters north and south of the city, and other related works.

The appendices are devoted to various subjects relating to, or throwing light upon this project. We give herewith a series of diagrams forming Appendix 3 of the report, showing, as will be seen, sections of various canals, proposed and completed. The second diagram will be noted as the one which is "insisted upon by Desplaines and Illinois valley interests, and incorporated in the Hurd Bill." The bill, with amendments, was favorably reported.

A word may be said here about the connection of the lakes and the Atlantic. Regarding the great trunk waterway that would be formed if both projects were carried through, the report says:

"It would make tributary every interior navigable water; would avoid transhipment, even at the coast; would pass by forty-five cities of over 10,000 inhabitants each, and an aggregate population of 4,500,000, and in the circuit by the Gulf and Atlantic coasts, would reach 56½ per cent. of the population gathered in cities. In carrying out such a project, large tributary water-ways would also be improved."

In discussing the effect upon the lakes of taking from them so large an amount of water it is suggested that works could be placed at the rapids in the Sault Ste. Marie river which would regulate the supply, and would conserve the vast volume of water that now goes to waste during high water. It would also be possible, by diverting to the lake some rivers which now discharge elsewhere, to supplement the volume of water in the lake. Storage reservoirs might be used to increase, in time of need, the volume of water now discharged by rivers into the lakes, while the whole project, together with the reservoir system on the upper Mississippi, would be a great help in improving navigation on the Mississippi river.

Recent Development of Rack Railways.

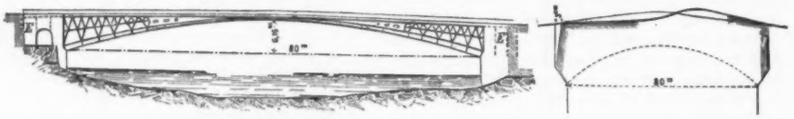
A. KUNTZE, in the *Zeitschrift des Vereines Deutscher Ingenieure*, speaks as follows of the recent development in rack railways:—Prior to 1880, ten lines had been constructed on Riggenbach's system—four of which were entirely rack lines, and six partly rack. Since that year, six rack lines, two partly rack, and seven rope railways with rack rails, have been laid on the same system. In 1882, Abt's system was introduced, and four lines have been constructed in this manner, while others are in hand. The best known line on Abt's system is that from Blankenburg to Tanne. Riggenbach's rack-rail has kept its original construction with little variation, the chief modifications being in the fastenings and in the use of iron cross-sleepers. The latter were adopted first on the Drachenfels line, then on the Niederwald and the Stuttgart and Degerloch lines, and on the Gaisberg (near Salzburg), and others. In the Brünig railway—a mixed line—the channel-irons are 8⅝ ins. high, so as to give sufficient clearance for the rack gearing when the engine is on the ordinary rails. In the Höllenthal line in the Black Forest, the ends of the rack teeth are not fixed in through the channel irons; but one in every four or five is screwed through. The teeth in this line are 2¾ ins. deep, and of corresponding width.

The failure of any one tooth in the Riggenbach's rack is of no material consequence as three teeth of the pinion-wheel are always bearing simultaneously on the rack—one fully, and the two others at one point of contact. On the Drachenfels line, one length of rail was tried, with one tooth missing, on a gradient of 1 in 10, and the train passed and repassed the place with no perceptible shock. The rack of Abt's system has the advantage over Riggenbach's on curves, as the plates can so easily be bent; but the latter system necessarily possesses greater lateral strength and stiffness. Abt's rack can be more readily adapted to any particular traffic, and is economical for light loads, as the number of plates can be reduced from three to two, and the thickness can be varied.

The details of the rack and locomotive on the Harz line have already been quoted; as an instance of a lighter construction, the rack on the Lehesten & Oertelsbruch line is formed with two plates, and the engine has two coupled wheels in two parallel sections, the strains on the rack being 3.7 tons. In each case the average pressure on any tooth is 0.98 ton. A series of Abt's rack-plates, tested at the Mechanical and Technical Laboratory at Munich, gave a result of 5.23 tons as the limiting pressure for one tooth. In Riggenbach's rack the main pressure on one tooth is between 3 and 4 tons, and maximum pressure about 7 tons; and on the Gaisberg line, where the larger wheels and two-coupled driving-wheels are employed, the pressure is 10 tons. Riggenbach's pinion-wheel has 33 teeth with 4 ins. pitch, and Abt's has 15 teeth with 4¾ ins. pitch; so that for every time one of the first comes into play the latter is used $\frac{33}{15} \times \frac{100}{120} = 1.8$ times. The present cost of the Riggenbach rack, complete *in situ*, is about $4.55 per lineal yard.

Failure of the Arcole Bridge.

The Arcole bridge, in Paris, built in 1855, was the first large wrought-iron arched bridge in France. The accompanying cut gives a general idea of its form. The large span and the slight rise give it the appearance of boldness, but also constitute the element of structural weakness, which has caused its failure. In order to increase its stability, its designer, M. OUDRY, prolonged the top chord, consisting of T-shaped plates, 12 ins. wide and 2 cm. (0.79 in.) thick, stiffened by 2 angle-irons, into the abutment, and anchored there at the points *E E*. According to a statement in the *Genie Civil*, these



Failure of the Arcole Bridge, Paris.

extension members from all of the 12 arches at the north of the bridge recently snapped with a loud report, causing one-half of the bridge to sink, and the other to rise, as exaggerated in the annexed figure. The ribs have a depth of 4.6 ft. at the abutment and only 1.27 ft. at the center, and the width of the flanges is 1.74 ft. The web is 0.4 in. thick. Both flanges consist of two plates, each 0.56 ins. thick, riveted together. They are fastened to the web with 4 angle-irons. The immediate cause of the breaks of the plates in the upper chord is not yet known, but is presumed to be the rusting of the material. There does not seem to be any cause to fear a total destruction of the bridge, and it is hoped that by loosening the anchorage on the other side of the river, and by proper weighting of the bridge it can be brought to its original shape.

Recent Researches in Friction.

(*Continued from page 266*)

INFLUENCE OF REDUCING THE WIDTH OF THE BRASS.

The author has found that the total frictional resistance is materially reduced by diminishing the width of the brass. Many experiments have been made to determine the relation which exists between these quantities, the results of which are given in Fig. 7; they were made under various conditions of lubrication, load and speed. The ultimate mean of all these curves is a close approximation to a logarithmic curve, where ordinates represent the total frictional resistances, and abscissas the chords of the brass in contact. Hence, from the properties of the logarithmic curve, the chords are in arithmetical progression, and the frictional resistances in geometrical progression; and when the frictional resistance has been found for any given chord, it can be determined for any other.

Divide the diameter of the bearing under consideration into 100 parts, and express all chord measurements in these units.

Let R_1 = the frictional resistance which has been found by experiment when the width of the chord is $= C_1$;
R = the frictional resistance which has to be determined when the width of the chord is $= C$.
Let r = the frictional resistance when the width of chord = 1 (or 0.01 of the diameter). This is termed the base of the curve.

Then $$R = r^c \quad . \quad . \quad . \quad . \quad . \quad . \quad \text{(I.)}$$

But this relation only holds when the first ordinate of the curve is unity, that is, the frictional resistance is unity when the width of the chord is zero. In order to reduce this equation to a general form, the first ordinate of the curve, whatever its value may be, can either be treated as unity, and all results expressed in terms of this unity; or equation (I.) can be slightly modified, so that the results shall always be expressed in terms of the conventional unit of frictional resistance, namely 1 lb., which appears to be the most convenient and simplest method.

Then equation (I.) becomes

$$R = R_1 (r^{c-c_1}) \quad . \quad . \quad . \quad . \quad . \quad . \quad \text{(II.)}$$

Where c is the width of the chord corresponding to the frictional resistance R, and c_1 is the width of the chord corresponding to the frictional resistance R_1.

Expressing it in a logarithmic form,

$$\log. R = \log. R_1 + \log. r\,(c-c_1) \quad . \quad . \quad . \quad \text{(III.)}$$

The base of the mean frictional-resistance curve is 1.0155, the log. of which is 0.00671.

Let $C_0 = C - C_1$, then equation (III.) becomes

$$\log. R = \log. R_1 + 0.00671\, C_0 \quad . \quad . \quad . \quad \text{(IV.)}$$

Example.—Given a shaft 5 ins. in diameter and a semi circular brass, the total frictional resistance found by experiment is 8 lbs.; it is required to find how much the friction will be reduced by cutting the brass down to 3 ins. wide, the total load remaining unaltered.

[Certain formulæ are omitted.—ED.]

Here $R_1 = 8$ lbs.; $\log. 8 = 0.90309$;
$C = 3$ ins. $= 60$ units;
$C_1 = 5$ ins. $= 100$ units;
$C_0 = -2$ ins. $= -40$ units.

Then from equation (IV.)

$$\log. R = 0.90309 - 0.00671 \times 40;$$
$$= 0.63469;$$
$$R = 4.31 \text{ lbs.}$$

Thus, by reducing the width of the brass from 5 ins. to 3 ins., the frictional resistance has been reduced from 8 lbs. to 4.31 lbs., or 46 per cent.

From equation (IV.) can be found the minimum frictional resistance which a given journal can run with under a given intensity of load, when the frictional resistance is known for any particular chord.

Let l = the length of the journal;
R min. = minimum frictional resistance;
W = total load in lbs. on the brass;
y = maximum safe intensity of load in lbs. per square inch on the nominal area of the brass.

Then the smallest permissible chord is

$$x = \frac{W}{y\,l}$$

and $$\log. R \text{ min.} = \log. R_1 + 0.00671\,(x - C_1).$$

The value of y varies with the nature of the load; when it is intermittent, as in a crank-pin, it may be much higher than where there is a continuous load, as in a carriage or locomotive axle.

Example: An axle 5 ins. in diameter carries a load of 7,500 lbs. on a semicircular bearing 10 ins. long; the frictional resistance is 50 lbs. The intensity of the load must not exceed 300 lbs. per sq. in. How much can the frictional resistance be reduced by cutting away the sides of the brass?

Here $$x = \frac{7{,}500}{300 \times 10} = 2.5 \text{ ins.} = 50 \text{ units.}$$

In locomotive crank-pins the nominal pressure per square inch is frequently about 1,400 lbs., and in crosshead-pins 2,000 lbs. In railway-carriage axles it is 330 lbs., and in locomotive and tender axles 250 to 300 lbs. per sq. in.

Then $\log. R$ min. $= \log. 50 + 0.00671\,(50 - 100) = 1.3635$
R min. $= 23.1$ lbs.

Thus the frictional resistance on this brass may be reduced from 50 to 23.1 lbs. without exceeding the safe intensity of load.

INFLUENCE OF WIDTH OF BRASS ON EFFICIENCY OF LUBRICATION.

In Fig. 7, several curves have been plotted to show the relation which exists between the frictional resistance of a brass, and the chord of its arc which is in contact with the journal when the total load on the brass remains constant. From the equation to the mean of these curves (IV.) the curve *a*, Fig. 7A, is obtained; and a similar curve *b* is plotted to show the same relation when the nominal intensity of pressure remains constant, that is, when the load is reduced in the same ratio as the projected area of the brass, which is shown in curve *c*. Then in case *a* the intensity of pressure increases as the brass is reduced in area; this increase varies as the reciprocals of the ordinates of *c*, and is shown in curve *d*: hence, as the intensity of pressure in *b* is constant, the curve *d* simply shows the ratio of the load in case *a* to the load in case *b* for any given chord. For it is evident that the total load on the brass in case *a* is greater than the load *b* for the same chords, and is in the ratio of *d* to 1; consequently, in frictional resistance it is greater than in case *b* by the difference of the ordinates of *a* and the ordinates of *b*, or by the vertical ordinates between the two curves; the ratio of *a* to *b* is shown in curve *e*, which simply indicates how the frictional resistance varies with the load, as shown in *d*. Now, as this curve *d* represents the load on the brass, and curve *e* represents the frictional resistance due to that load, the ratio of *e* to *d* is the coefficient of friction, curve *q*. The total load on the brass in *a* is constant, curve *f*, then $q \times f$ is the total frictional resistance of the brass, which is shown by curve *g*.

The difference between the curves *g* and *a* demonstrates how the efficiency of the lubrication varies for different widths of brass, for in both the curves *a* and *b* the lubrication was presisely the same; therefore any variation of lubrication is eliminated from curve *e*, and hence curve *g* shows how the frictional resistance would vary if the film of lubricant were as good for a wide as for a narrow brass. This diagram also shows that the lubrication is most efficient in reducing the friction when the brass subtends an angle of from 120° to 60°, whereas the author found, by his experiments on the wear of brasses, that the film is probably at its best between the angles 80° and 110° (Figs. 3 and 4). The curves (Fig. 7A) represent relative, not absolute, values, therefore no vertical scales are given. The curves on the right hand of the same figure show the same relations as those on the left hand; the former are plotted to real normal pressures on the surface of the journal, the latter are simply nominal pressures; a comparison of the two is instructive in demonstrating the amount of error involved in taking nominal pressures, as is usual in practice.

The normal pressure on a brass is greater than the nominal pressure, as will be seen by comparing curves *f* and *f'*; let *W* be the total load on a semicircular brass, and *P* the resulting normal pressure distributed over its surface, then the relation is—

$$\frac{P}{W} = \frac{4}{\pi} \text{ (Cotterill's "Applied Mechanics," p. 247).}$$

The various ratios of $\frac{P}{W}$ have been calculated for the smaller chords, and plotted in curve *f*, from which all other curves are obtained. The curves *b*, *a'*, and *b'* were obtained from the results of the experiments, and equations found for each; these in every case agree very closely with the experimental curves.

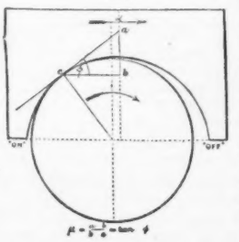
The equations are of the same form as (IV.), the only variation is in the value of the bases, which are—

For curve *b*, $\log. r = 0.00824$
" " *a'*, " $= 0.00763$
" " *b'*, " $= 0.00636$

SIPHON LUBRICATION.

The results of a set of experiments with siphon lubrication are given in Tables XVII., XVIII., and XIX. [not here reprinted]; on account of the lubrication having been very imperfect and irregular, they are not included in the mean results stated in Table VII. As the brass had to be reduced in width, diagonal grooves for oil were inadmissible; therefore a straight groove along the crown of the brass had to be resorted to, both ends being open, which allowed the oil to get to the bearing surfaces, which it would not do without this precaution.

FIG. 3.



WEAR OF BRASSES.

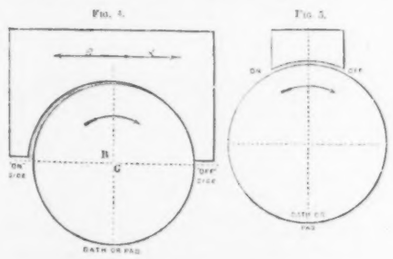
When the chord of a brass is reduced, in order to diminish the frictional resistance, the arrangement should be such that the resultant line of pressures on the bearing bisects the chord at right-angles, so that the wear shall be symmetrical about this line. Yet even when this precaution is taken, the brass does not always wear centrally, but acts in a peculiar manner.[1] A brass is shown (Fig. 3), which is bored too large for the shaft, so that there is only line contact between them. When the shaft revolves the brass is carried forward in the direction of the arrow; consequently the brass is worn more on the on-side than on the off-side. But the author has found that with a well fitting semicircular brass the wear is exactly the reverse; that is, the wear now takes place on the off-side, and continues to do so until it subtends an angle about 100°, when the wear becomes central. If the chord be still further reduced, the brass behaves like the one which fits its shaft loosely, the wear taking place on the on-side. The author also found that the wear was practically central between 80° and 110°.

[1] Minutes of Proceedings Inst.C. E., vol. lxxxv., p. 392.

The brass which was used in the first part of these experiments was plain, without any oil-groove. In a second set of experiments made with an oil-groove, into which an oil-hole was drilled, the wear invariably took place on the off-side, even with the narrowed chords in contact, and with every system of lubrication, and the wear was much more rapid than before.

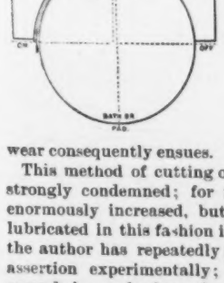
The cause of these peculiar effects is not altogether clear; the author thinks that the surface of the brass in contact is not equally lubricated, and this opinion is supported by the curves in Fig. 7A; hence, where the lubrication is deficient, the wear is greatest.

Evidently two different forces act on the brass. One force is its tendency to be carried forward by the revolving shaft, the other is the wedging action due to the clinging of the oil-film to the shaft, so that when the lubricant on the shaft meets the on-edge of the brass, it must either be skimmed off by it, or it must get in between the surfaces, and so force the on-edge away from the shaft. The direction in which the brass moves is dependent upon the magnitude of the horizontal component of these forces, and the wear will take place on the side opposite that in which the brass moves. Whether the oil ever gets in between the shaft and brass will de-



pend upon the normal pressure at the on-edge; with a semicircular brass this pressure is zero, and the oil gets in without difficulty, but as the brass is reduced in width this pressure increases to a maximum with line contact. Let the first named of these forces be called α, and the second β. Fig. 4 represents a semicircular brass, from which it will be seen that the on-side is thoroughly lubricated, and the off-side is nearly dry; this is a case in which the force β is greater than α, so that on putting the shaft into motion the brass moves diagonally in the direction $C\,B$, and wear takes place on the off-side. When the arc in contact is much reduced, the action of β is reduced on account of the increased normal pressure, until a point is reached when $\alpha = \beta$ and the brass remains central; the film of oil is thereupon equally distributed over the whole surface in contact, and the wear is consequently central (Fig. 5). If the arc in contact be still further lessened, β is so much reduced that α becomes greater than β, the brass moves in the direction of α, and wear takes place on the on-side of the brass. Generally, the force α will vary with the frictional resistance of the brass.

Fig. 6 represents a brass, where an oil-groove is cut along its crown, and an oil-hole is drilled through the top of the brass into it; the wear in this case is invariably on the off-side, which is probably due to the oil escaping as soon as it reaches the crown of the brass, and so leaving the off-side almost dry, where the wear consequently ensues.



This method of cutting oil-grooves cannot be too strongly condemned; for not only is the friction enormously increased, but a bearing cannot be lubricated in this fashion if a siphon only is used; the author has repeatedly proved the truth of this assertion experimentally; if, however, a small scratch be made from the oil-groove to the end of the brass the oil will flow, but the lubrication will be imperfect. Although many railway axle-bearings made in this way give fairly good results, it must be remembered that there is a great deal of jar on them, which allows the oil to get between the surfaces better than it would if the motion were steady; and again pads are used as well as siphons in every case in railway practice.*

Several experiments were made under various conditions to ascertain whether the brass floated on the oil completely when running. For this purpose, lubricants were used which were non-conductors of electricity; one terminal of a battery was attached to the brass and the other to the shaft, and a galvanometer was placed in the circuit. This was invariably deflected, proving that there was either actual metallic contact between the bearing and shaft, or that extremely thin films of oil are conductors when a larger bulk of them are not, or possibly the small particles of brass in the oil, which had worn from the bearings, made metallic contact.

SOLID COMPARED WITH LIQUID LUBRICANTS FOR HEAVY MACHINERY.

When oil is used as a lubricant for heavy machinery, much difficulty is frequently experienced from the heating and seizing of the bearings, yet when a solid lubricant is used it runs perfectly, although the natural coefficient of friction and temperature of the latter are much higher than of the former.

The natural coefficient and temperature are those to which a bearing attains when running with an ample supply of lubricant under a given load and speed. Thus, from a commercial point of view, these natural values do not give the true value of the lubricant, and a further test is therefore necessary, namely, to find the coefficient of friction of rest after the bearings have been standing several hours. The reason of the excessive heat generated when oil is employed is probably due to the oil being squeezed out when standing, then with the first revolution of the shaft abrasion takes place, on account of the surfaces being dry, which necessarily causes a great deal of subsequent heating and frictional resistance. On the other hand, a solid lubricant is not squeezed out by standing, so that there is always a film of it left between the surfaces. The following results of the author's experiments support this view, the nominal load per square inch on the brass being 58 lbs.:

Lubricant Used.	Natural. η	Natural. Temper'tre	η of rest after st'ndig 16 hrs.	Ratio of η of rest to nat'l η.	Rat'o of nat-ur'l η	η of re't
		C'n'g'e				
Bell's Asbestos oil,	0.0084	34.0	0.192	22.9	1.0	2.1
Price's valve oil, { B thi'k and A, vic's	0.0252	50.0	0.147	5.8	3.0	1.6
	0.0329	37.5	0.1715	5.2	3.9	1.9
Bell's Astestoline, hard solid grease	0.0350	40.0	0.090	2.6	4.2	1.0

SPEED EXPERIMENTS.

Speed experiments were conducted under varying conditions of lubrication, size of brass, load and temperature, the results of which are given in Figs. 8, 9, 10. It is evident from these curves that the rate at which frictional resistance increases with the speed is much greater with meagre than with good lubrication, the curves become flatter as the amount of lubrication increases.

When the nominal load per square inch is below about 60 lbs., which corresponds in this case to the brass subtending an angle of 90°, the frictional resistance regularly decreases with a reduction of speed; but when the intensity of the load is greater; the frictional resistance increases when the speed falls below about 50 ft. per minute; the exact point at which this change occurs cannot be well defined, as it is greatly affected by the load and temperature. The change-points are clearly seen from the figure referred to above. With low speeds a greater load than 60 lbs. per sq. in. appears to squeeze the lubricant out, and consequently to increase the friction.

If the speed remains constant, the load at which the change-point occurs varies in an inverse ratio of the temperature. The lubricant becomes more fluid as the temperature rises, and is more easily squeezed out (Fig. 12).

Thus it is clear that a given lubricant, when used for low speeds, will only support a certain intensity of pressure at a certain temperature. Whenever the conditions of the author's speed experiments agreed with those under which Mr. TOWER worked, his results also agreed very closely; for example, with loads above 60 lbs. per sq. in., and bath lubrication, the frictional resistance varied as the square root of the velocity,† as deduced from the results of bath lubrication for brasses below 1.5 in. wide.

After the lubricant has been squeezed out, the machine runs unsteadily and vibrates a great deal, which makes the readings difficult to observe, and very uncertain. If the brass be gradually loaded without jar, the friction may be kept down very low, indeed far below its change-point; but on slightly jarring the machine the friction is instantly enormously increased; or if the brass be kept constantly moving laterally, the load can be so adjusted when near the change-point, that the addition of 2 or 3 lbs. on the brass will just pass the limiting load, and increase the friction tenfold.

COEFFICIENT OF FRICTION OF A BRASS SLIDING LATERALLY ON A REVOLVING SHAFT.

Several experiments were made to determine this "lateral" coefficient of friction, the results of which may not be of much practical value, beyond showing that it is in some instances an infinitesimal amount.

The author found, in all his experiments, that it was practically impossible to keep the brass in one place on the shaft when the machine was properly levelled; for if the operator moved from one end of the apparatus to the other, the brass with its load of 550 lbs. would invariably slowly slide to the end at which he was standing; although the floor was very firm and solid. In one instance the circumferential velocity was 200 ft. per minute, and the lateral velocity about 0.05 in. per minute; thus the shaft became in effect a very fine-threaded screw. The "lateral" coefficient of friction in this case is, therefore,

$$\eta = \frac{0.05}{200 \times 12} = 0.000021.$$

Generally, the lateral coefficient varies directly as the lateral velocity, and inversely as the circumferential velocity.

The results of the experiments are given in Fig. 16 As they are somewhat limited, no definite laws can be deduced for every form of ball bearing, but the following laws appear to hold for the special bearing used:—

I. The coefficient of friction of ball bearings is constant for varying loads, hence the frictional resistance varies directly as the load.

II. The friction is unaffected by a change of temperature.

The experiments with the white neutral oil are rather irregular, but a mean of them shows clearly, as with the pale American oil, that the coefficient of friction is nearly constant, and when this is the case the frictional resistance varies directly as the load.

The second law was found thus:—The bearing was heated by a Bunsen gas-burner from 20° to 60° Centigrade, but no difference could be detected in the friction; it was then allowed to cool while running, but without any appreciable change. This experiment was repeated with different lubricants, loads, and velocities, with the same result.

The coefficient of friction with ball bearings is rather higher than that of plain bearings when bath lubrication is used; but it is lower than when they are lubricated by the ordinary methods. They will also run easily with a much smaller supply of oil than will a plain bearing, hence there is a decided advantage in favor of ball bearings.

An experiment was made to find what load the bearings would carry, the revolutions were 100 per minute, and loads were added by 10 lbs. at a time; on reaching 587 lbs. one of the balls broke, and from the appearance of the fracture it was evident that there was a flaw in the metal. Another ball was substituted, and a second experiment was made, and when the load reached 610 lbs. the belt slipped so much that the back gear of the lathe had to be put in, which reduced the revolutions to 20 per minute. When the load reached 1,250 lbs. the bearing began to grate and whistle, even when a fresh supply of oil was put in; on removing the load, the bearing was taken to pieces and examined, and to all appearance was as good as ever. The friction was very great with the high loads, and the machine

* Minutes of Proceedings Inst. C. E. vol. lxxxv., p. 387.

† Minutes of Proceedings Inst. C. E. vol. lxxxv. p. 384.

Fig: 1.

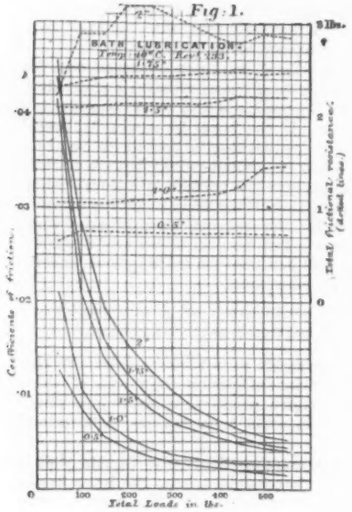


Fig: 4.

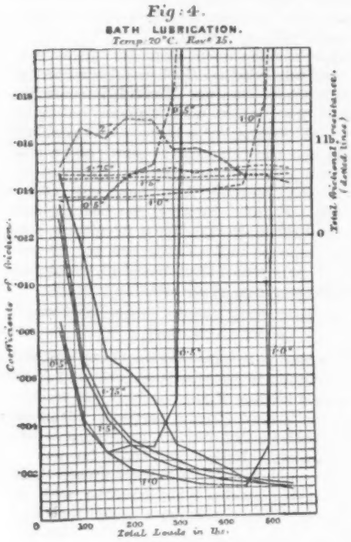


Fig: 7.

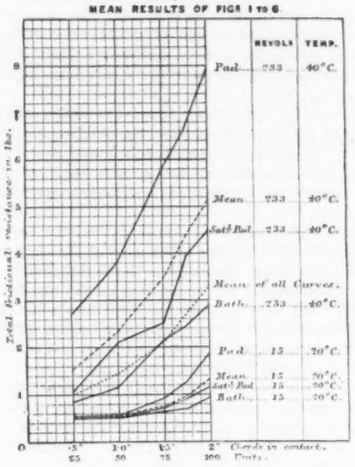


Fig: 2.

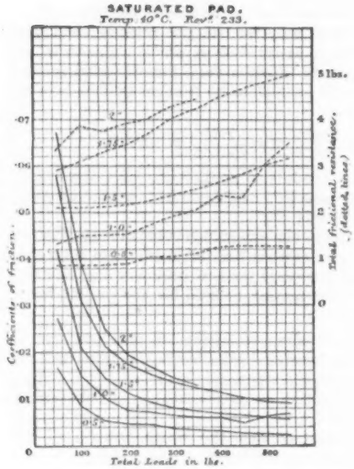


Fig: 5.

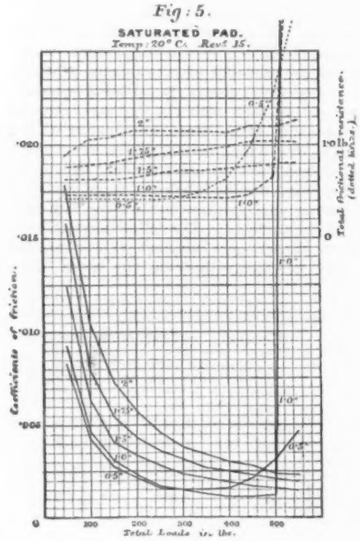


Fig: 7A

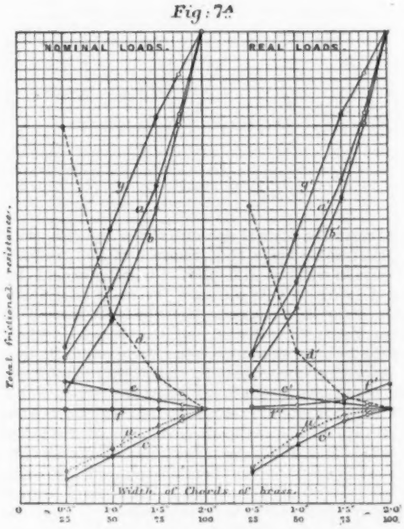


Fig: 3.

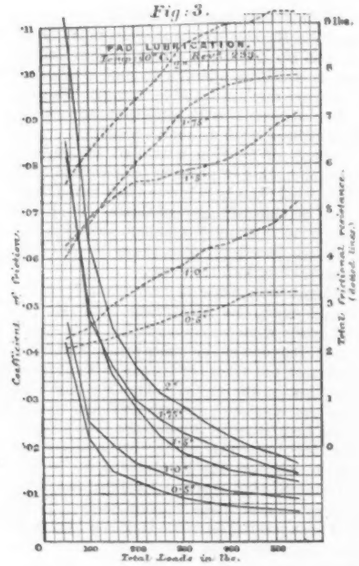


Fig: 6.

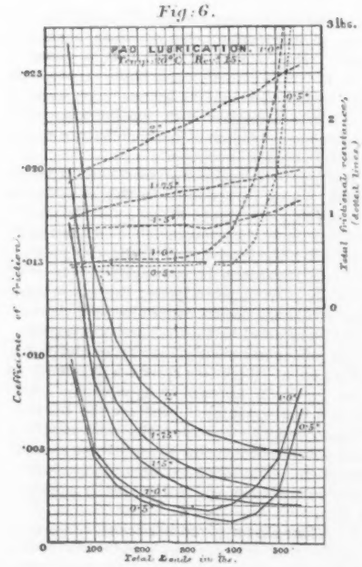
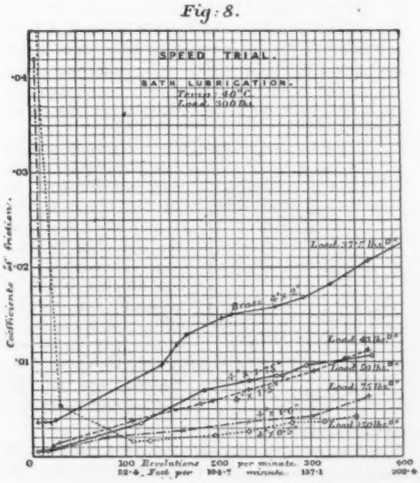


Fig: 8.



Diagrams Illustrating Results of Tests of Friction of Lubricated Bearings.

vibrated to such an extent that it was impossible to measure it.

In conclusion, the author expressed thanks to Prof. ALEX. B. W. KENNEDY, M. Inst., C. E., of University College, London, for affording facilities for experiments and for suggestions on the arrangement of the apparatus and manner of experimenting.

Fig. 9.

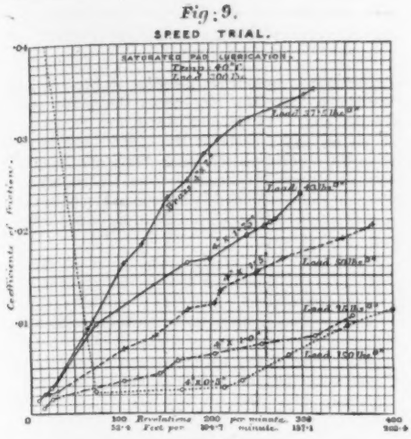


Fig. 10.

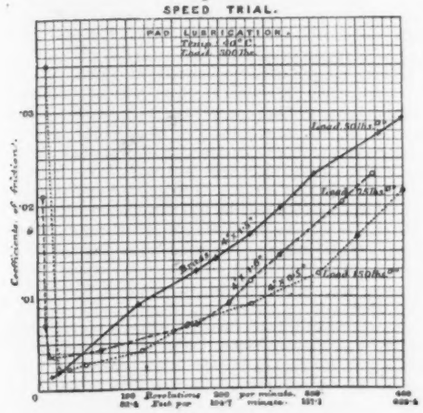


Fig. 12.

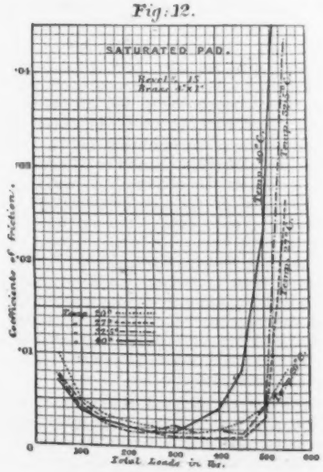
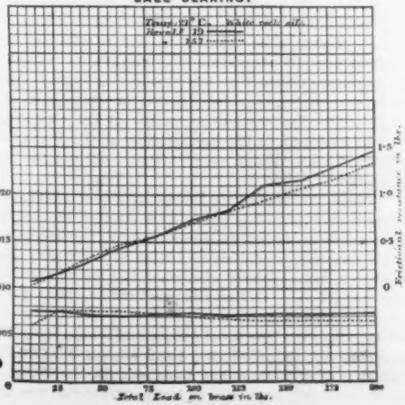


Fig. 16.



The New Jersey State Survey.

The work of this survey is now nearly completed, and the first part of the final report will soon be issued. It will be upon the Physical Geography of New Jersey, giving the results of the Geodetic, Topographic and Magnetic Surveys, together with an atlas of the elaborate maps which have been published in series, and which have justly excited such universally favorable comment. In the Annual Report of State Geologist GEO. H. COOK, which we have just received, it is stated that, as could with certainty be expected, constant reference is being made by outside parties to the maps and records in the office of the State Geologist, especially for information regarding important enterprises whose success depends largely upon the geological and topographical features of the State.

The Topographical Survey has been under the charge of Mr. C. C. VERMEULE, and the field work is already completed. Last years' work consisted of original surveys in the northeastern part of the State.

The mapping and engraving for the survey during the past year, has been done under the direction of Mr. FRANK VAN BRAKLE. The original topographical sheets on a scale of 3 ins. to the mile are all to be published, and have been sent to the engraver. A finely executed small map of the State on a scale of 5 miles to an inch accompanies the report. Nearly all the series for some years in publication on an inch per mile scale are already completed.

We have already described, the work of this survey at various times in our columns, but as it is now completed, is the first of its kind, and has been admirably conducted we give below an extract from the report, describing connectedly the whole survey and the manner of preparing its results for publication:

PLAN OF PUBLICATION.

"All the manuscript maps of the survey are on a scale of 3 in. to a mile, or 1 in 21,120. These sheets average 5x10 ft. in size, and are twenty in number.

"The engraving is executed on a scale of 1 in. to a mile, or 1 in 93,360, and each of the above sheets requires four stones about 17 by 18 in. in size, two being for roads, streams and lettering, and two for the contour lines, making 80 stones in all. Several of these stones are grouped on one transfer stone to form an atlas sheet. These are all of the same size, and as large as they can be conveniently printed on a single sheet of paper. After a number of trials to ascertain what would best fit the irregular shape of the State, and the geological belts which cross it obliquely, having regard also to the location of important centers of population and business, the plan shown on the accompanying small map of the State was adopted.

"The entire State requires 17 sheets to cover it. Each sheet is 24x34 ins. in size. At first view it will be thought that they overlap each other and require an extra amount of engraving. The overlapping is not more than enough to give room for titles to the maps, and the engraving is not increased, as the printing is not done from the engraved stones directly, but from transfers which can be joined together in any way that may be required.

"The numbering of the maps is generally from the north towards the south, and they are arranged so that those covering the same geological formation can be easily grouped together, thus:

Nos. 1, 2, 3 and 4 cover all the Archæan and Paleozoic rocks.
Nos. 2, 3 and 4 cover all the Archæan rocks and all the iron ore district of the State.
Nos. 5, 6, 7 and 8 cover the red sandstone formations.
Nos. 8 and 9, with 10, 11 and 12, cover the clay and marl districts of the State.
Nos. 8, 9, 10, 11, 12, 13, 14, 15, 16 and 17 cover the Tertiary formations.
Nos. 9, 13, 16 and 17 cover the entire Atlantic shore.

"The sheets can be taken separately or the whole together. The maps are all drawn on the same system of projection, so that any two adjoining ones can be cut, fitted accurately to each other, and made into a single map, or they can be folded across and put in an atlas of 17x24 ins. These, with a map of the whole State, on a scale of 5 miles per in. on the same sized sheet with the others, make up the Topographical Atlas of New Jersey.

THE AIMS AND RESULTS OF THE TOPOGRAPHICAL SURVEY.

"This survey was begun in 1877, to meet the imperative wants of the Geological Survey and the demand for good maps for economic uses in a rapidly-advancing community. It was designed to produce primarily a topographical map, as accurate as the scale of one inch to a mile would admit of; with the addition of as much information of a purely economic nature as could be introduced without interfering with this object. It has been conceded to be the pioneer Topographical Survey of America. Some of its results have now been several years before the public, and as it covers a district which is densely populated, and perhaps more carefully worked over by civil engineers, in designing and executing public works, by geologists and other close observers, many of whom have borne testimony as to its practical value, we have the pleasant assurance that the survey has fully accomplished its object, and in some directions even more than it was originally expected to do. As yet there is no reason to doubt that the work has been designed and executed in a manner which best subserves the interests of the State.

"It is only to be expected that a community so highly developed and wealthy will, before many years have passed, demand a cadastral and economic survey, such as European states of like density of population are prosecuting. With the present Topographical Survey in hand to fill our immediate necessities we are prepared to proceed with such a work with the deliberation and care which its character will demand. The greater scope of usefulness of a Topographical Survey enables it to give larger returns for the comparatively small amount expended in it, and forbids that it shall be indefinitely delayed and withheld from its fields of usefulness by being in any way connected with or dependent upon the completion of these necessarily tedious and expensive cadastral or economic surveys. This lesson has been learned everywhere in Europe, where state surveys have reached a high development.

COST OF THE TOPOGRAPHICAL SURVEY.

The whole amount expended for salaries and expenses of the topographical corps in field and office during the prosecution of the work has been $59,892.95. Of this amount, $5,148.37 was devoted to work not chargeable to the Topographical Survey proper, leaving $54,744.58 as the total cost of field work and the preparation of manuscript maps on a scale of 3 ins. to a mile. This amounts to $6.93 per sq. mile, or 1⅛th cts. per acre. It includes a triangulation covering 2,000 sq. miles, and a large amount of proof-reading, work on reports and other office work incidental to all surveys. By promptly availing herself of the offers of co-operation in the work and its results, extended by the national surveys to all States undertaking and prosecuting surveys of their domain, New Jersey has secured this survey at a cost of but half the above sum, the remainder being borne by the national organizations. The topography found already executed reduced the cost of topographical work about 50 cts. per sq. mile, while our experience shows that had we also been compelled to furnish our own triangulation the cost of executing it in a manner just suitable for the needs of the Topographic Survey would have swelled the total expense to nearly, but certainly not more, than $10 per sq. mile.

While we claim for the Survey that it is as accurate as the publication scale demands, and in many places much more accurate than this scale warrants, being intended to serve as the basis for larger scale maps of important sections when they are needed, we of course consider it but fair that its small cost should be kept in view in judging of its merits.

CONTROL OF THE TOPOGRAPHY.

"A good estimate of the accuracy of the results of the survey can only be formed from a personal inspection of the maps in the field. As already noted, many competent judges have made this inspection and have expressed themselves satisfied. But for the benefit of those who cannot do so, but still wish to form an opinion as to the accuracy of the work, we submit a short statement of the measured control of the survey. Keeping in mind the fact that topography is made up of irregular curved surfaces and lines, which can only be determined mathematically by the location of an infinite number of points, it will be seen at once that mere measurement alone will never suffice to produce a topographical map. All good topography is executed by the aid of sketching, and therefore the number, distribution and accuracy of measurements which control the sketch, together with the truthfulness of the sketching, which varies with the largely innate qualifications of the topographer for his work, serve as a measure of the quality of the result.

"Primarily, the control of this work rests on a triangulation by the United States Coast and Geodetic Survey, filled out and extended by the topographers so as to include a total of 458 stations, determined with what we may consider absolute accuracy. These stations are very close along the sea-coast and large rivers, but in the interior they average one to each 25 sq. miles and are about 5 miles apart. The next step in securing measured control is the running of traverse lines over the whole area at an average of 2.53 miles of traverse to each square mile of territory, which is equivalent to a rectangular network with squares having sides of four-fifths of a mile. In important districts the lines are closer; in flat, level and unimportant sections they are farther apart. The distribution of the highways being suitable for the purpose, they have been mainly followed in traversing, for convenience, the work being done with facility and suitable accuracy with a barrow odometer. A transit and stadia were sometimes substituted when the other method was inapplicable.

From this network of traverse lines, which were closely connected with and adjusted to the triangulation, all important points of topography were located by traversing with a prismatic compass and pacing, these paced lines being checked out on a main traverse line opposite the one from which the start was made. All streams of importance were followed in this way, and all summits and ridge-lines were thus visited, studied and located. It has been found that an experienced topographer can by such means secure good location, and results as accurate generally as the scale can exhibit. Topographers have averaged over four miles of walking to each square mile of sketching, thus studying and representing all topography at short range. The bays, creeks and marshes of the coast, as well as important rivers, were surveyed with transit and stadia. Heights have been determined almost entirely by the spirit-level. A network of primary levels formed the basis for this work, the levels for topography being run rapidly with a light engineer's level. Elevations may be relied on to the nearest foot. This accuracy was deemed necessary because of the extensive use made of the work in the solution of important engineering problems of water supply, drainage, etc., and the many demands made on the survey for accurate data for such purposes. To secure it may have added somewhat to the cost of the survey, but no one familiar with the growing importance of these questions to the greater portion of the people of the State will doubt that the increased efficiency thus secured will well repay this.

"The following table exhibits fully the amount of instrumental work which has been done to secure good control for the topography.

"The most natural classification of the topography is one conforming to the geological structure. This classification has been followed in the table. The Archæan and Paleozoic districts are hilly or mountainous in character, consisting of ridges and irregular plateaus, rising to 1,800 ft. above the sea and quite frequently 1,000 ft. above the neighboring valleys. The area in timber varies from 40 to over 90 per cent., and this increased the cost of surveying. Triassic topography consists of a rolling plain, occasionally broken by protruding ridges of trap-rock. Forests cover from 25 to 50 per cent. of the area. Cretaceous topography is made up of irregular low hills, rising to about 350 ft. above the sea at the highest part, or of gently undulating plains, traversed usually by crooked ravines with steep banks and flat bottoms. The first portion has about 40 per cent. in timber, the latter not over 20 per cent., but the whole area is covered with many scattering tree-clumps and hedge-rows, which interfere considerably in topographical work. The timber in this area is also very tall. The Tertiary formation is represented by extensive and extremely level plains of sand, covered by a pine forest. The streams meander through flat valleys and are usually bordered by impenetrable swamps of white cedar, often miles in width. Elevations seldom rise above 200 ft. The sea and Delaware bay shores are fringed by open tide-marshes, traversed by an intricate network of creeks and broken by many bays.

SUMMARY OF WORK OF THE TOPOGRAPHICAL SURVEY.

DISTRICT.	Area.	LEVELING.			TRAVERSING WITH ODOMETER.		
		Number of miles.	Miles per sq. mi.	Stations per sq. mi.	Number of miles.	Miles per sq. mi.	Number of stations.
Archæan and Paleozoic	1,524	3,435	2·25	14·2	3,429	2·25	.....
Triassic	1,551	4,192	2.70	15.1	4,920	2·50 to 6·40	.....
Cretaceous and Tertiary	4,340	6,948	1·60	7.2	10 419	2.40	.....
Averages and Totals	7,415	14,575	1·97	10.2	18,768	2·53	211,679
Primary Levels	.....	1,114	Transit Traverse.		956	.....	3,576
Grand Total	7,894	15,689	.....	.....	19,724	.....	215,255

"The levelling and odometer traversing were confined to 7,415 sq. miles of upland. The methods of surveying tide-marsh were different. The transit work was mainly on the latter area. The areas in the first column are based on the results of a new measurement of the area of the State which is not quite completed. The total area given excludes the large water areas of Delaware and Raritan bays.

"The points determined by triangulation by the topographical parties number 156, making with those furnished by the United States Coast and Geodetic Survey a total of 458 points utilized in the maps.

"The above is a sufficient exhibit of the control of the sketching. Taken with what has been said of the manner of executing the sketching it should serve as a measure of the reliance to be placed on the results.

"The following time record of the survey will serve to show the proportion of labor devoted to each portion of the work. The time given is in days' work of one man. The topographer in charge carried on triangulation and other field and office work in person, supervising the work of the party at the same time, as much as possible. When the whole of his time was required for administrative duties this time has been charged to supervision, otherwise to the class of work in which he was mainly engaged.

	Days' Work.
Levelling and sketching simultaneously	8,083
Sketching, without levelling	760
Primary levelling without sketching	708
Traversing with odometer	2,145
Transit traversing	713
Triangulation	467
Office work, including plotting and also much miscellaneous work incidental to all surveys	4,159
Supervision	892
Total	17,926

"No deduction is made for Sundays or for stormy days in the above record. It includes all of the time devoted to work which appears in the results of the Topographical Survey proper, excluding a considerable amount of miscellaneous office work having no bearing on these results.

A very useful map in relief has been prepared under the direction of Mr. COOK which gives the drainage and sources of water supply of the State. The report has a few words of interest on artesian wells. Wells of this kind in the Atlantic border south of Raritan river have mostly been successful. Parts of this section are underlined by a "water-bearing stratum in the clay deposits over the marl." A boring at Atlantic City which should have tapped this stratum at between 500 and 600 ft. was unsuccessful in getting water, and has been sunk still lower. It is now down 1,121 ft. and a water-bearing stratum has not yet been opened. It is nearly down to the upper marl-bed, underneath which good water has been found at Winslow and Berkeley Arms. In boring wells through the soft, earthy materials which comprise the formations in this section much skill is required. An account is given of an inexperienced contractor who bored for 500 ft. without obtaining water and gave up the attempt. An experienced man put down a well only a yard or two distant, striking water at 297 ft. The report continues:

Borings in the red sandstone are uncertain. A well at New Brunswick, bored for Messrs. Johnson & Johnson, in the red rock, is 480 ft. deep and yields a moderate supply of very hard water. One bored in the red sandstone in the marsh west of Hoboken is down 250 ft. but yields only brackish water.

A well has been sunk at the clay-banks of Sayre & Fisher, at Sayreville, on the right bank of the Raritan, to get a supply of pure water for steam boilers. It is 8 ins. in diameter. The first 70 ft. were in clay, and then gneiss rock was met. The well is now 893 ft. in the gneiss, and no water has been met, and it is not likely that any will be found, though the boring is still continued.

At the suggestion of the managers of the Geological Survey a tract of land known as the Great Meadows has been drained, and 5,000 acres of almost worthless land thus reclaimed and made the best in the State. A tract of land on the Passaic river, between Little Falls and Passaic, will soon be drained. This probably over 10,000 acres in extent, and is peculiarly located, being low, level land surrounded by hills, the drainage from which overflows the lower area,

Aside from the Annual Reports of the State Geologist, which are printed as legislative documents, and widely distributed, other publications of the survey are: "The Report on Fire and Potter's Clay of New Jersey," "The Preliminary Catalogue of the Plants of the State," and "A Topographical Map of a Part of Northern New Jersey." The complete atlas will soon be ready, and bids fair to be both interesting and useful. The sheets will be 27 by 37 ins., and there will be 17 of these maps showing sections of the State. A new Geological Map of the State, on a scale of 6 miles to the inch, will appear in the atlas, with two other general maps.

The City Gas Works of Philadelphia.

Philadelphia is somewhat peculiar as regards its gas supply in that the city owns the plant and makes the gas. As private firms are reluctant about giving full details of the cost of operating their works, the following items from the annual message of Mayor FITLER, and from the report of Director of Public Works WAGNER concerning the gas supply plant of Philadelphia will be of added interest to our readers.

It is said that "the city's works failed to satisfactorily meet the increased demand for gas during the past winter months," and that it needs to be extended and equipped with the latest improvements. It seems that various parties tendered bids for the purchase or lease of the works last year, and all the bids "contained provisions for the expenditure of a large amount of money for remodelling the plant, showing conclusively their opinion of the condition of the same." A gas ordinance has been passed to give an increased supply. The report says that for the current year "the operations of the Gas Works were larger than in any previous one, the amount of gas manufactured and the coke tar and other residuals produced being largely in excess of all previous years. The cash receipts, notwithstanding the reduction in the price of gas from $1.60 to $1.50 per 1,000 cu. ft., were more than at any time during the past ten years. The amount of coal carbonized was 671,631,600 lbs., which at 4.70 cu. ft. to the pound equals 3,154,842,000 cu. ft. The amount of gas consumed was as follows: by the various departments and public buildings, 65,941,700 cu. ft.; by street lamps, 440,558,181 cu. ft.; used at works, offices, stations, etc., 25,651,800 cu. ft.; unaccounted for, leakage, etc., 441,340,419 cu. ft., making a total of 3,585,255,600 cu. ft. The largest production of gas for any one day was on December 23, when 12,821,000 cu. ft. was manufactured. The largest consumption was on December 24, when 13,415,000 cu. ft. was consumed. During the year 9,467,785 bushels of coke were made; 5,533,795 bushels were sold and 3,956,000 bushels were used under the retorts, boilers, etc. The production of gas per pound of coal was 4.70 cu. ft. The cash receipts for the consumption of gas, etc., for the year was $3,816,641.09. There have been 4,263 new meters introduced during the year, 129,788 now being in use. 94,400 new lights have been added, making a total in use of 1,980,999. The total number of consumers is 118,644. Length of gas mains laid, 121,593 ft., equal to 23 miles and 153 ft. The entire length of pipe laid and in use, 878 miles. The gross profits were $684,356 90."

"Among the many improvements made during the year the most important is the erection of a new purifying house at the Ninth Ward Works. New boilers have been introduced in nearly all of the works. The 12-in. main to Germantown and Chestnut Hill was completed during the year, and another 12-in. main was laid on Oxford Street, west of Broad Street. The average candle power of the gas was equal to 17.65 standard candles."

"The needs of the Bureau of Gas are: increased production of at least 3,000,000 ft. per day, increased holder capacity and larger distributing mains. The former difficulty would be met by the erection of additional retorts and purifying houses in connection with the Twenty-fifth Ward Gas Works. The second difficulty will be met by the erection of a holder in the Fifteenth Ward station, capable of holding 2,000,000 cu. ft. of gas. The third difficulty is one that demands prompt attention. Complaints of 'bad gas,' a popular misnomer for 'insufficient gas,' have been numerous, especially from the consumers living in the Northwestern portion of the city. This can be ascribed to the destruction of the Fifteenth Ward Works. To remedy this evil more pipes are required."

"There are 354 electric lights, at a cost of $87,974.53 and 5,297 gasoline lamps, at a cost of $116,586.09. The Northern Liberties Gas Company furnishes gas for 472 lamps, at a cost of $10,701.45. The gas furnished to lamps under charge of the Bureau of Gas has cost $16,473. Of these lamps thus supplied, 1,062 are not lighted now, because of their proximity to electric lights. The total number of lamps is 22,596, and they are supplied at a total cost of $215,262.07. The sum of $174,126.85 has been paid by the Bureau for the maintenance, etc., of lamps under its care. If the city had been charged the same rate as charged

to private consumers the cost would have been $486,711.42."

The Record of Two Years' Strikes in the State of New York.

The fifth annual report of the New York State Bureau of Statistics of Labor contains a very interesting table of comparisons between the strikes and boycotts of 1886 and 1887, which we give below. From this table it will be seen that the number of strikes in the State was not so great for 1887 as for 1886, although they have been numerous. Among the causes for strikes, the report gives a large number of boycotts; 113 because of the employment of non-union men; 469 for an increase in wages, and 20 because of a reduction in wages; 115 for a reduction of hours, and 9 because hours had been increased; 148 to assist other trades, and about 140 because various labor organizations, or their rules, were ignored. The remainder of the 1,064 strikes in 1887 were caused by various grievances, among which are 2 against the use of wheelbarrows, 4 against the use of machinery, and 2 against the contract system. There were causes given for at least 12 strikes which seem commendable, "non-payment of wages;" while the most base, unjust and tyrannical of all the strikes are 100 *against the number of apprentices employed*. The table speaks for itself.

	1886.	1887.	Total.
Number of establishments affected by strikes	2,061	1,604	3,665
Number of trades and callings affected by strikes	137	144	281
Results of strikes:			
Successful	751	694	1,445
Compromised or partly successful	426	190	616
Doubtful	212	3	215
Unsuccessful	524	695	1,219
Pending	147	22	169
Number of persons engaged in strikes	127,392	51,731	179,123
Number of persons engaged in threatened strikes	.....	1,005	1,005
Number of persons refused work after strike	6,391	8,176	14,567
Loss of wages as result of strike	$2,552,554.00	$2,013,229.45	$4,565,783.45
Amount expended by labor organizations for relief of members and the conduct of strike	329,080.00	217,069.78	546,149.78
Estimated gain in wages to strikers	a1,420,085.02	944,632.55	2,364,717.55
Number of persons obtaining benefit of estimated gain in wages	31,832	11,472	46,304
Estimated gain to employers as a result of strikes against a reduction of wages	$39,468.00	$142,588.00	182,056.00
Losses to employers:			
From failure to fill contracts	692,885.00	481,730.20	1,174,615.20
From refusal of new contracts	603,522.00	217,202.00	820,724.00
From diversion of trade	1,448,420.00	183,109.00	1,631,529.00
From injury to machinery and goods by strikers	64,020.00	198 583.00	262.603.00
From injury to machinery and goods through the inexperience of new employés	8,575.00	43,590.20	52,165.20
Number of establishments closed during strikes	572	*708	1,280
Number of women and girls engaged in strikes	29,361	5,015	34,376
Number of threatened strikes	57	71	128
Number of persons engaged in sympathetic strikes	10,905	5,220	16,125
Number of firms discriminating against labor organizations	152	171	323
Number of boycotts	163	242	405
Results of boycotts:			
Successful	19	101	120
Partly successful	7	.....	7
Unsuccessful	13	36	49
Doubtful	b11	.....	11
Pending	3	105	108
Breaches of the peace and arrests	371	48	419
Mode of settlement of strikes:			
Arbitration	c11	d6	17
Conciliation	249	21	270
Conciliation with employés	81	121	202
Conciliation with labor organizations	832	667	1,499
No formal settlement	20	52	72
Abandoned	430	696	1,126
Blank	386	41	427

a These figures represent an actual gain for the year given, and also an actual gain for the year 1887, as no strikes are reported in the establishments in which the employés who obtained this gain worked. To be strictly correct, the estimated gain of 1886 should be repeated for 1887; this would make the total gain in wages for the two years $3,784 802.55.

b One hundred and ten failed to report result.

c Nine establishments were engaged in one general strike. One shop strike was settled by State Board of Arbitration and one by Railroad Commissioners.

d One by State Board of Mediation and Arbitration and five by Mayor of Rochester.

* Seventy three were partly closed.

ENGINEERING NEWS.

THE Metropolitan Street Railway Company, of Kansas City opened its Twelfth Street Cable road, 4 miles in length, on April 7. The line connects the eastern city limits with the stock yards in the western part of the city and desends the bluff on an iron viaduct with a grade of 14 per cent. The line was constructed under the direction of Messrs KNIGHT & BONTECOU of Kansas City, who have been prominent in the work of the development of rapid transit facilities by cable railways which has assumed such proportions in Kansas City. Up to date the firm have built 15 miles of double track cable lines for the Grand Avenue and the Metropolitan Companies as follows:

	miles
Fifth Street Line	1½
Grand Avenue, Fifteenth Street & Westport Lines	7
Wyandotte Extension Fifth Street Line	4
Twelfth Street Line	2½

A CIRCULAR has been sent out by the United States Commissioner of Agriculture for the information of railway managers concerning the relative merits of white and chestnut, or tan-bark, oak for railway ties. It states that white oak is so much sought after for use in various industries that it is decreasing very rapidly and will soon be exhausted. The chestnut oak is equally good for ties, and as it is felled in some sections of the South wholly for tan-bark, vast quantities of timber that would make thousands of ties are left to rot. It is reported from Cullman, Ala., that posts of chestnut oak outlast those of white oak. This may be on account of the bark having been stripped from the former. However this may be, a table in the circular shows that chestnut oak is superior to white oak in weight per cubic foot, in specific gravity, in resistance to indentation, in elasticity and in transverse strength.

AT the Otis Iron and Steel Works, Cleveland, O., electricity is called upon to take the place of hand labor in lifting steel billets, ingots, and other heavy pieces of iron. For the construction of the electro-magnet to be used for this purpose, two bars of soft iron were taken, each being 14 ins. long and 3 ins. in diameter. They were wrapped with strands of No. 14 B. & S. gauge, covered wire. To combine the two separate magnets thus formed into one they were linked together on the top by a third soft bar, square in the cross-section. For trial of the magnet at actual work it was suspended by a rope from a pneumatic crane. Rope was used, as it was found that a chain became magnetized and did not act very well. The current sent through the wire to induce the magnetism measured 5½ to 6 ampères. It was found that a weight of 800 lbs. could be lifted up handily, and by lowering the magnet and shutting off the current the load could be deposited anywhere very easily.

FROM tables prepared by inspectors of English mines it appears that in the past 20 years the increase of the total output of coal from the mines of the United Kingdom has been about 60,000,000 tons, or an increase which is equal to the whole output of Continental Europe, Germany excepted. The greatest increase has been in the South Wales district. The production of 1887 exceeded that of 1886 by 4,500,000 tons, being 162,119,812 tons against 157,518,482 tons in 1886.

GOOD work has been done in the northwest this last winter by the LESLIE rotary snow plow. On the Chicago & Northwestern Railway one of these plows cut its way through drifts 16 and 18 ft. deep, and at a rate of a mile in 40 minutes. This railway company has since ordered two plows for next year. Various improvements are to be made in the plow, among them, a wrought-iron in place of a cast iron head, and an automatic governor to prevent the plow from racing when it passes out of a drift. The successful operations of the plow in the last two years prove that it has before it a great field of usefulness.

THE project for building a "winter bridge" across the Detroit river is being revived, after having slumbered for some time, according to outward appearance. The Cleveland Board of Trade has passed resolutions against it and justly, it seems to us. There are no sufficiently serious engineering difficulties in the way of a tunnel to make the saving from building a "winter bridge," which would inevitably become a summer bridge also, really justifiable, and the water way is too important a one to be unnecessarily obstructed by a bridge of any kind.

The Business Situation.

The volume of business throughout the country is of less proportions than usual up to this date for many reasons, of which the following are the most important: The common business sense of the country has felt it necessary to check a further expansion of activity. The railroad builders have recognized the fact that further construction, except in isolated localities, is fraught with great risks. The real estate speculation west has made a reaction a possibility whose effects might be disastrous to new enterprises. A tariff agitation and a presidential campaign bring up the rear of causes that restrain the greatest possible commercial and manufacturing activity. Railroad builders are not yet fully convinced as to the effects of the new railroad law upon earnings. Taking it all in all, the business world feels it to be the wiser policy to make progress more slowly during 1888. On the whole, the action is wise. Prices preserve a downward tendency in nearly all branches of trade. There is no symptom of over production, over trading, or over crediting. Demand and supply are kept pretty nearly at an equilibrium. The rate of interest on money is not burdensome, and the great bulk of investments made are in legitimate, rather than speculative, channels. Naturally there is considerable anxiety to test the influences upon trade and manufacturing in the event of a general reduction of tariff duties and increase of the free list. The opposition to this policy is, as it is not unnerving to expect, made up more or less of apprehensions. The real ability of the country to endure healthfully a sharp tariff reduction has never been tried. Where one person, five or ten years ago, had confidence in the nation's ability to withstand hurtful influences from this cause, there are eight or ten now. Yet there are good reasons on both sides against and for the trial of this projected economic policy. If there are slothful or unenterprising men and methods supported by existing duties, they will be removed by the change. The strongest feature in our general markets is the extraordinary volume of business held back. The best manufacturing and commercial authorities anticipate a sharp and general improvement, for all kinds of products, as soon as the downward tendency has exhausted itself. It seems to be generally accepted that railroad building will not reach the extraordinary limits of last year, and there is a wide spread belief that the distribution of products generally will be somewhat curtailed. The iron and steel mills are not crowded, as they were last year. Three or four rail mills are idle. Rails have declined from $40 to $31. New roads are projected in nearly every State in the Union, and rail makers are waiting impatiently for a return of the old demand, which kept mills sold from six to nine months ahead. Bridge builders have had very little leisure, and from advices recently to hand, bridge making capacity will be kept busy throughout the season. Car builders have been overcrowded for months, and orders are still crowding capacity. Rolling stock is even now scarce on many roads and managers are waiting the execution of orders on hand to place additional ones. Locomotive works are making overtime at three or four points.

The supply of white and yellow pine, hemlock, spruce, and the hardwoods is equal to the present demand and prices are low. The rapid increase in saw and planing mills, north and south, and the opening up of valuable timber lands, by new railroads, is helping to expand productive capacity and to accordingly depress prices. The general depression in prices is controlled, in a measure, by the increase of trade and corporate organizations, which seem to restrict competition and regulate supply and demand to the extent, at least, of crowding prices down to cost of production. Our best railway authorities assert that the trunk lines will enjoy as large a business this year as last. Building authorities are of the opinion that as much business will be done this year as last. Manufacturers of machinery, of engines, boilers, tools, and appliances, and shop men, and foundrymen all think that the volume of business will not fall much behind last year when the year's business is tabulated. So far this year results do not justify such hopeful views, but our experience in former years justifies us in believing a rapid expansion in trade during the latter half of the year as all together possible and probable. The fact that a national body of uncertain law-makers are tinkering with our vital business interests no doubt accounts for somewhat, perhaps a great deal, of the hesitancy manifested by traders, manufacturers, promoters, and projectors, and the wheel horses generally in trade, finance and manufacturing.

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AND

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D. McN. STAUFFER. A. M. WELLINGTON.

EDITORS.

GEO. H. FROST, - - - BUSINESS MANAGER.

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Drawings for publication *should preferably be in plain black and white, considerably larger than they are expected to appear, with letters and figures in pencil only, all lines clean and bold.*

Coming Technical Meetings.

American Society of Civil Engineers, New York.—Regular meeting, April 18. Secy., John Bogart, 127 E. 23d St.

American Water-Works Association.—Annual meeting at Cleveland, O., Apr 17, 18, 19. Secy., J. H. Decker, Hannibal, Mo.

Boston Society of Civil Engineers, Boston, Mass.—Regular meeting, Apr 18. "Methods and Apparatus Used in the Recent Test of Water Meters at Boston," L. Frederick Rice Chairman of Meter Testing Commission. Secy., S. E. Tinkham, City Hall.

Engineers' Club of St. Louis, Mo.—Regular meeting, April 18. "Gas Producers," C. M. Woodward: "A Well Ventilated Mine," Lewis Stockett. Secy., W. H. Bryan, 709 Market St.

Engineers' Club of Philadelphia, Pa.—Regular meeting, Apr 21. Secy., Howard Murphy 1126 Girard St.

Engineers' Club of Kansas City, Mo.—Regular meeting, May 7. Secy., Kenneth Allen, 19 Deardorff Building.

Civil Engineers' Society of St. Paul, Minn.—Regular meeting, May 7. Secy., Geo. L. Wilson, City Hall.

American Society of Mechanical Engineers.—Next meeting at Nashville, Tenn., May 8 to 11. Secy., F. R. Hutton, 280 Broadway, New York City.

Master Car Builders' Association.—Next convention at Alexandria Bay, N. Y.; commencing June 12. Secy., M. N. Forney, 45 Broadway, New York City.

American Railway Master Mechanics' Association.—Next meeting at the Thousand Islands, N. Y.; June 19. Secy., Angus Sinclair, Chicago.

Roadmasters' Association of America.—Next meeting at Washington, D. C., Sept. 11. Secy., H. W. Reed, Waycross, Ga.

TWICE within less than a year the office of this journal has been saved from destruction by being in a fire-proof building. In the first instance a fire in the building alongside cracked our windows and burnt out the office underneath us. In the second instance, a few days since, there was a very serious fire in the top floor of the building, which would, in all probability, have destroyed the whole building, had it not been of fire-proof construction, whereas in fact only one or two rooms were burned out.

Such incidents well illustrate the economy as well as safety and security resulting from the fire-proof type of construction. We have had figures on hand for some time, waiting to be put into proper shape for publication, which show clearly that, what between fire premiums, fire losses, cost of fire department, and other such direct expenses, with the most moderate estimate of the uncompensated losses from interruption of business and loss of papers, and the most moderate valuation on loss of life and limb, it is actually a dead loss of many millions yearly to the American people to allow any other than fire-proof construction in the heart of our great cities. The matter can be regulated as is the use of wood for building, by forbidding within certain districts which have reached a certain stage of development any other than fire-proof construction. Thus in a decade or two an entire change is gradually brought about, and the ever-present danger of sweeping conflagrations diminished from the first. The influence of all intelligent men should be thrown in favor of such action.

AT the regular monthly meeting of the Brooklyn Bridge Trustees on April 9 it was decided that a special meeting should be had on Tuesday, April 17, to consider the report of the Board of Experts and also a report to be made by the Terminal Committee transmitting the Experts' report, and also estimates of cost and other details and recommendations. It was expected that this business might come up at the regular meeting, and there was in consequence an unusually full attendance, but the papers and estimates were not ready for transmission, so that in the meantime there is still opportunity for "the opposition" to the recommended plans—which so far as yet appears is confined to Mr. PULITZER of the *World* —to continue to publish absurd exaggerations of probable cost, which the *World* has worked up to five, six or even ten millions, while $2,000,000 is actually an outside sum. The French's Hotel lot which the *World* must close, and which Mr. PULITZER, has just bought for $630,000 is certainly a most admirable one for a newspaper building, but the fear of its loss would hardly lead a journal of any character or responsibility to the extreme which the *World* adopted. After an unsuccessful "still hunt" among various engineers for opinions in opposition, as we happened to learn, it manufactured out of the whole cloth a bogus interview with Mr. ALBERT FINK, which Mr. FINK immediately declared by letter and in person to be absolutely without foundation, for two very good reasons (1) that he had not yet examined the plan at all, and (2) that so far as he had any impressions they were entirely favorable.

THAT a bridge of some kind over the Hudson river at New York is greatly needed is too clear for demonstration, but the bill lately introduced by Judge GREENE seems open in many ways to very serious objection. It leaves the location of the bridge entirely to the discretion of "Commissioners", for the limitation between 10th and 181st Sts. amounts to that, and we all know how competent "Commissioners" are apt to be for such work. It plainly contemplates the erection of a cantilever, and stipulates for the placing of one pier in the river channel, neither of which should be permitted unless found absolutely necessary, even if the cost be considerably increased. If there be one place in the world where a mere "utility structure" should not be permitted, but where dignity and beauty of form should be a controlling feature, it is over the North River at New York, and in that and other respects the suspension type seems to us to have great advantages for the location. The very able paper by Mr. GUSTAV LINDENTHAL embodying his design for such a structure, which ran through several of our early numbers for this year, seems to us to embody a plan which is clearly practicable and which in its substance outlines the structure which should be built, although it may well be still susceptible of much improvement in detail. The main expense of any such structure must lie in the piers and approaches, and the saving which might result from the use of a cheaper style of superstructure—if there be, in fact, any cheaper for equal durability and strength—would be comparatively small and should not in our judgment outweigh the advantages of beauty of form and absence of river piers.

WE conclude this week Mr. GOODMAN'S interesting and valuable paper on Friction, with a series of diagrams which are the most complete so far compiled, and enable one to see at a glance the nature of several of the most important "laws" of friction, if it can be said to have any laws. We are compelled by lack of space to postpone the discussion of the laws of lubricated friction which we had intended should accompany the paper, and will now only add this caution, that, while the diagrams are no doubt correct so far as they go, they should not be accepted at their face value as decisive as to the laws of friction. The one great law which seems to us better established than any other is that the *character and abundance* of lubrication is the one important factor, and that in comparison with it the effect of the quality of oil, temperature, speed (after passing the very slow speeds), pressure, and all other conditions except decently good order of the bearings, sink into insignificance. We cannot but believe that as science and the mechanic arts advance, and as the pressure of competition becomes greater and greater, bath lubrication of bearings will become more and more general. For all stationary machinery the problem of such lubrication is not inherently very difficult compared with hosts of others which have been successfully solved, and in all shops with many bearings to take care of it would undoubtedly effect a great economy of power and wear and tear. Even for railway service, although the problem is much more difficult, the practical elimination of appreciable axle friction which might be secured should encourage great efforts to secure it.

THE death of Gen. QUINCY A. GILLMORE, which is announced in another column removes another of the fast falling heroes of the war and an eminent and able engineer as well. As a military man Gen. GILMORE'S popular fame rests chiefly on his successful planting and destructive use of the famous "Swamp Angel" battery at Charleston, as to which there is the mythical story that one of his officers who was ordered to plant the gun and "make requisition for anything he wanted" made out a requisition for "50 men 100 ft. high to wade through a swamp 80 ft deep." The difficulties overcome were very great, and Gen. GILLMORE'S conspicuous success in combating them brought him at once into prominence so that he was enabled to render most important service later, up to the end of the war. His greatest service to engineering was perhaps his still standard treatise on "Limes, Cements and Mortars," the result of exhaustive tests and investigations which the outbreak of the war interrupted, but which were then, fortunately, practically complete. His practical engineering experience and services, however, were great and varied, as will appear more fully from the sketch of his life elsewhere. Personally he was a man beyond reproach, an honor alike to his profession, his corps and his country.

As illustrating what derailed wheels can do sometimes in the way of adhering to the track a correspondent calls our attention to an incident which is perhaps without parallel, although it happened so long ago as 1872. In that year a derailed axle ran all the way from Bay St. Louis to New Orleans, 60 miles, over the New Orleans & Mobile R. R. (now a part of the Louisville & Nashville system) leaving

its mark on the ties all the way, and passing over numerous trestles with no floor system to speak of, and aggregating over a mile in length. There were numerous curves in that distance also, but all of quite easy radius. If any one knows or has ever heard of a longer run of a derailed wheel than this we shall be glad to know of it, but it may safely be assumed that no *much* longer run than this ever occurred. But little damage was done at any point.

Such incidents, which are of almost daily occurance on a smaller scale, admirably illustrate how wide a field of usefulness there is for the Latimer re-railing device. If one were put in at every mile or oftener, whether at a structure or not, a very large percentage of the smash-ups from derailments would be entirely averted, since it is rather the rule than the exception that the train runs a considerable distance before the final smash-up happens, and sometimes it does not happen at all. No such device can be always effective, but in the extraordinary case that we mention there were probably a dozen or two points in succession where re-railing guards should have existed, and would have put back the wheels had they been there.

STAMFORD, Conn., had rather a lively meeting of tax payers and voters on April 3, at which the sewerage system, designed by Col. GEO. E. WARING, Jr., and recently built, was freely discussed. It seems that the opposition were in a majority at the meeting of about 3 to 1. The work was attacked as being inadequate, that the pipes were already stopped up and that the system was a gigantic failure. A defence was made by the chairman of the sewer committee, yet a resolution was carried calling for a strict investigation before the final payments are made. The trouble seems to lie in the fact that the pipes are nearly all 6 ins. in diameter and that they have very soon become filled up, probably because but a small number of houses, only one in ten it is claimed, were connected, furnishing but a slight flow of sewage and therefore allowing deposits to form. Another difficulty probably was that there were no manholes, from which the pipes could be properly cleaned. It should hardly need much more demonstration and costly experience to show that the absence of manholes is indefensible, and that 6 in. pipes for street sewers are too small to give satisfaction. The same experience which Stamford is now passing through has been had in a number of other places. In Memphis, which was the champion city for 6 in. pipes and where at least 10 per cent. of the sewers have this size, the City Engineer has concluded to build no more of less than 8 ins. in diameter, and hereafter to put a manhole at every street intersection.

THE profession of architecture is far in advance of that of engineering in having an established code of professional charges for specified work. On ordinary buildings it is 5 per cent. for complete plans and supervision. The Texas State Association of Architects has recently advanced on this, and fixed the charge of 7 per cent. for all buildings costing less than $5,000. The late H. H. RICHARDSON charged 10 per cent. for all his ordinary buildings, including some very large ones, and had no trouble in getting it. We hope to see the day when engineers of established reputation can obtain similar fees for their services; but there seems small immediate prospect of it.

THE present Emperor of Germany barely escaped from a terrible danger in June, 1874, near the Wildpark Station, in the outskirts of Potsdam. He was driving across the rails, when suddenly the heavy gates, which are worked from a considerable distance, were let down on the approach of an express train. His carriage was thus caught between the two closed gates, and it was only by the most superhuman efforts that he was able to raise one of them and to get the vehicle off the track before the train rushed by. Thus was illustrated, in a most conspicuous way, one of the greatest dangers of automatic or any other kind of gates operated from a distance, that they will be shut regardless of people crossing, in a way to do harm to them. We trust the Emperor now has a firm conviction that over or under crossings are the best precaution, and may live until they are universal in Germany and all other thickly settled regions.

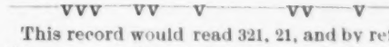
The American Inventors of the Telegraph.

The "bubble reputation" is dear to every man, and for some reason which it would be hard to explain logically, but which is fortunate indeed for mankind, reputation after death is almost as dear and as much valued as that enjoyed during life. The same instinctive feelings which make us value our own good reputation during and after life, make it painful to all men of any generosity of feeling to unwittingly do injustice to either the living or the dead, by robbing them of just renown, even in what can really concern them so little as posthumous renown.

An article in the April *Century* under the well known name of Mr. FRANK. L. POPE appears to bring to light an important instance of such injustice on the part of nearly the whole world in regard to the respective services of Prof. SAMUEL F. B. MORSE and Mr. ALFRED VAIL in the invention of the electric telegraph. It can matter nothing to either MORSE or VAIL in what regard they are now held. Both are long since dead. But it will be shocking to every just-minded man to feel that he has been doing such injustice to one that his name even is unfamiliar, to aggrandize the reputation of the other, when they are in fact entitled to almost equal honor. That this has been so must, we think, be the conviction of every one who reads the article referred to.

The facts, briefly stated in chronological order, appear to be these: STURGEON, an Englishman, in 1825, discovered that a soft iron horse-shoe surrounded by a few helical coils of wire became a magnet when a current of electricity was passed through the wire. He did not discover that the intensity of the magnet increased with the number of coils, nor that the intensity of the current increased with the number of cells. Prof. HENRY, in 1832, discovered these facts and "actually constructed and operated an electric-magnetic signalling apparatus which was as truly an electric telegraph as that of to-day." It operated by ringing a bell through over a mile of wire, and had there been operators then able to "read by sound" and an existing telegraphic alphabet, this apparatus as it stood could have been used for practical telegraphy, a use which Prof. HENRY then suggested. But even the possibility of "sending" without mechanical aid had not then been conceived, still less an alphabet, and that men could learn to read by sound would have seemed a wild suggestion.

Prof. MORSE, in January, 1837, independently reinvented the conception of electric telegraphy, adding the vital conception of a recording apparatus, without which telegraphy could hardly have become general, although the recording feature has now almost passed out of use. He then built and privately exhibited the first of all practical telegraph instruments, a rough wooden frame, which still exists and is on public view in a glass case in the basement of the Western Union telegraph building in this city, where by the way it should no longer be, but in the National Museum. He used the old STURGEON battery and hence could only send signals through a few feet of wire. He operated his "key" mechanically by leaden toothed types which are still shown in a box near the aforesaid wooden instrument, and "received" by a continuous line on the familiar paper strip which was broken by V-shaped jogs when a tooth passed under the key, thus:



This record would read 321, 21, and by referring to a numbered dictionary, which Prof. MORSE' completed "with much labor", the record was interpreted. The miscalled "Morse alphabet" was not yet.

This apparatus, in this state, was shown to MORSE's professional colleague, Prof. GALE. He knew of HENRY's prior results, which MORSE did not, and suggested the addition of the multiple coils and multiple cells. These features were at once embodied, a much longer circuit was successfully worked, and in September, 1837, the apparatus was exhibited to a considerable party, among others to ALFRED VAIL, the son of a very prominent iron manufacturer. VAIL was profoundly impressed, and "before leaving the room" undertook to secure MORSE financial aid for an interest in the invention. He had had a liberal education and mechanical training in his father's works, where had been forged the shaft of the first steamship (the *Savannah*) and the tires, axles and cranks of the first American locomotive (so it is said, although the name of the "first" engine is not mentioned). It was soon arranged that VAIL was to construct at his own expense and exhibit before Congress a telegraph "of the plan and invention of MORSE" in consideration of a one-fourth interest, and well did he fulfill that contract.

VAIL and a boy named BAXTER, afterwards the inventor of the Baxter engine, were soon locked up in a room, which is still sacredly preserved intact, and through difficulties and discouragements manifold completed the instruments (Jan. 6, 1838) which after some years' delay for lack of means wrote the historic sentence at Baltimore as sent from Washington, "What hath God wrought?" MORSE was present only from Oct. 29 to Nov. 13, during which time a substantial duplicate of his first machine, in metal instead of wood, was constructed.

But the machine next constructed and used, which by the testimony of BAXTER was in its new features the sole invention of VAIL, differed in the following vital respects: A vertical register making *dots, dashes and spaces* was substituted for the continuously marking, laterally moving pencil, which was almost impossible to keep in working order. This then suggested to VAIL's alert mind the principle of the misnamed "Morse alphabet." In the words of BAXTER:

"He saw in these new characters the elements of an alphabetical code, and instantly set himself to work to construct such a code. His general plan was to employ the simplest and shortest combinations to represent the most frequently recurring letters of the English alphabet, and the remainder for the more infrequent ones. For instance, he found that the letter e occurs much more frequently than any other and accordingly he assigned it the shortest symbol, a single dot (·). On the other hand, *j*, which occurs infrequently, is expressed by dash-dot-dash-dot (— · — ·). After going through a computation to ascertain the relative frequency of the recurrence of the different letters of the English alphabet, ALFRED was seized with a sudden inspiration, and visited the office of the Morristown local newspaper, where he found the whole problem worked out for him in the type cases of the compositors.

"In this statement I have given the true origin of the misnamed 'Morse' alphabet," the very foundations and

corner-stone of a new system, which has since become the universal telegraphic language of the world."

Custom has now made this telegraphic alphabet a commonplace of science, but it had then been in no way foreshadowed, and it would be impossible to exaggerate its surpassing merit and far-reaching importance. On it indeed the fame of Morse as the inventor of the telegraph *par excellence* largely rests, for Wheatstone and others were dabbling more or less effectively in cumbrous forms of telegraphy at about the same time, and the English have ungenerously attempted to enthrone Wheatstone as its inventor in advance of Morse. It is not impossible, in fact it is probable, that Morse had more or less to do in completing and perfecting the alphabet, but it is clear that Vail needed no assistance, and hence it seems painfully unjust that the alphabet should not be known by his name.

But this was not the end of Vail's services. He invented later the self-interrupting circuit breaker, now used for ringing bells, the axial-magnet, used in electric arc lighting, the ampére-meter, the substitution of the earth for a metallic return-circuit, and the operation of two or more circuits from one battery. He also invented the embossing of the paper record by a stylus in combination with a grooved roller, and the modern sending "key" as we know it, in substitution for Morse's cumbrous mechanical types. All these devices appear to have been without suggestions from Morse, (although he may well have had some share in them indirectly) and as to the embossing, Vail left a written statement that "Prof. Morse gave me no clue to it". The first of all "keys", as made by Vail's own hands, is still on exhibition in the case before referred to, and later, after operators persistently received by sound, Vail invented the modern "sounder."

These facts, which we infer to be unquestioned and unquestionable, fully justify Mr. Pope's statement that "the essential telegraph of to-day comprises solely the work of Joseph Henry and Alfred Vail. The elements contributed by Morse have gradually fallen into desuetude." Morse's part was still perhaps the most essential, and fully entitles him to be mentioned first among the originators of the modern telegraph, as is cordially recognized in Mr. Pope's article, but surely it is equally clear that "the distinguished associate and friend of both, Hon. Amos Kendall" spoke well in saying:

"If justice be done, the name of Alfred Vail will be forever associated with that of Samuel F. B. Morse in the history and introduction of the electro-magnetic telegraph."

And it gives one a painful shock to see that Prof. Morse, in the zenith of his fame and ten years after Vail's death, at a public dinner to do him honor, could find no more cordial words than these in which to speak of his great associate:

"In 1835 [the telegraph] lisped its first accents a few blocks only from the spot from which I now address you. It was a feeble child indeed, * * * but *it had then all the distinctive features and characteristics of its present manhood.* It found a friend, an efficient friend, in Mr. Alfred Vail, of New Jersey, *who with his father and brother furnished the means to give the child a decent dress preparatory to its visit to the seat of Government.*"

The first italicized statement is certainly not true. Of the father and brother, the second was enough to say, and it alone was no small honor, but to Alfred it was not enough, although true of him in even greater measure, and after reading it, one is prepared to believe what Mr. Pope says elsewhere with further evidences, that "from the time when the apparatus was first exhibited in New York to the last day of his life, Morse appears to have evinced a certain disinclination to acknowledge the full proportion of credit to which, as time has shown, his associate was entitled," and we are better prepared to appreciate at its full worth that nobility of spirit and self-sacrificing humility which led Vail during his life-time to fail to make public claims for his inventions, in part from underrating their importance, in part from indisposition to throw any cloud of dispute upon the feeble childhood o the invention, and in part from a mistaken belief that his contract and partnership with M[illegible]se forbade him to take out patents of his ow[illegible].

It is possible that there may be other facts still to be presented which will diminish the painfu impression of those here narrated. At the most they should not lead to too harsh judgment of Morse. It is natural to all men to honestly overrate the importance of their own thoughts and deeds in comparison with those of others, and even to do a shade less justice to others than we are inwardly conscious they deserve. However much we may admire those who rise above such pettiness, we should not do the less justice to the many benefactors of mankind who have not quite been able to do so. The relations of Boulton and Watt were in much less degree of something the same nature. Boulton is not remembered as he should be. But it is sad to think of such services as Vail's being so nearly forgotten, and with no disposition to rob Morse of his just fame we have felt bound to do what we could to end such injustice.

Natural Gas and Oil.

The last annual report of the Philadelphia Company gives one a vivid idea of the great value of the natural gas supply, and at the same time of its probable instability. The company gives a list of 67 active wells owned April 1, 1887. Of these there were:

Drilled in 1878,	1
" " 1882,	1
" " 1883,	5
" " 1884,	8
" " 1885,	14
" " 1886,	27
" " 1887, (3 mos.)	7
Leased, no date given,	4
Total	67

The great Westinghouse well, which led to the formation of the company, struck gas on May 30, 1884.

This continued drilling is in part due to the constantly enlarging consumption, and in part to the mere desire to develop the territory. Nevertheless, it clearly indicates that there is nothing very stable about the supply. The income last year was $1,500,161, and the expenses 65.65 per cent., or excluding rents 55.77 per cent. This was reduced in the first three months of last year to 44.90 per cent., but even that figure indicates that even when gas is obtained for nothing from a hole in the ground, there is a good deal of expense attending the mere handling of it, since this includes no charges for drilling new wells, but merely the ordinary maintenance and office expenses for looking after 412 miles of pipe, 56,278 acres of controlled territory, 85½ miles of telephone line, and an unspecified number of individual consumers. Again, out of the total capitalization (unavailable assets) of $8,245,966 the gas wells proper stand charged with only $496,115, and including the gas rights and leases there is only some $2,000,000, while the pipe lines alone have cost nearly $5,000,000.

In view of the universal judgment of geologists that the natural gas supply is a strictly limited quantity, which once exhausted will not be renewed, these figures are rather encouraging. It is not probable that when the evil day comes when the supply gives out any one but the owners of the wells will have much occasion to grieve, and perhaps not they. There is a great deal of expense attending even the getting, handling and delivery of natural gas. It is all but certain that, the demand for vast quantities of gas once created, it can be filled by artificially made gas very cheaply, and perhaps at no very enormous increase over the total cost of the natural gas supply. Already the cost of artificial gas to consumers bears no rational or just proportion to the cost of manufacture in large quantities, and with the stimulus to invention which will result from a demand vastly greater than has heretofore been dreamed of, it is more than probable that it will be made proportionately cheap, and that the indirect benefit of the natural supply, in causing a change in manufacturing processes which would otherwise have been very slow to come about, will prove even greater than its direct value. Already it has had this indirect effect in not a few instances. A number of works in various parts of the country, among which the Dominion Bridge Co., of Montreal, is a prominent example, are using gas exclusively which is made from coal carried a long distance.

It is at least a possibility that the exhaustion of the petroleum supply, which seems to be slowly approaching, will prove no evil, and be perhaps a "blessing in disguise". The marvellous progress in electric lighting, and especially in storage batteries (although this last is not as rapid as it might be) holds out every promise of more than supplying its place, so that the demand may even fall off enough to indefinitely prolong the supply. The universal opinion seems to be that the supply is in no sense renewable, and there is certainly a distinct falling off in Pennsylvania production, although not so great a one as to be immediately alarming, even without remembering that the enormous Ohio supply has led to its artificial curtailment. The Ohio oil, however, is not the equal in quality of the Pennsylvania oil, nor is there any reason to suppose that the supply is anything like as great. The total amount of oil which has so far been produced in marketable form is now a little more than 330,000,000 barrels. When less than half this quantity had been produced in 1882, it was predicted that the utmost remaining supply was under 100,000,000 barrels. This prediction has been distinctly falsified, and no one now ventures to set definite figures for the quantity which remains, especially as there are known supplies of unknown magnitude in various parts of the world. Nevertheless it would seem that the days of *cheap* petroleum must be numbered, as were the days of cheap whale oil a generation or so ago. The lack of a decent illuminant, in fact, was a very serious matter when kerosene first began to be manufactured from coal. Whales had been almost exterminated; "burning fluid", made up of alcohol and turpentine, was a poor and dangerous substitute, lard oil was an objectionable and dear substitute, and the world beyond the reach of gas had a good prospect of sitting in darkness. But petroleum suddenly solved the problem. The hunting of whales fell off at once and they have since multiplied greatly, and all the artificial products are forgotten as if they never were. It would then, or even five years ago, have been exceedingly difficult to imagine any practicable substitute for petroleum for general use, and yet a sudden decrease of supply may yet do no more harm than to hasten the general use of a better and perhaps even a cheaper light.

To look for a cheaper light seems almost chimerical, yet it must be remembered that the bare cost of oil is only a part of the expense. The expense and annoyance from caring for and maintaining the lamps is also to be

allowed for. In the meantime, without specifying particular devices, the manufacture of incandescent lamps and of storage batteries is advancing with very great rapidity. Available power which now goes to waste exists everywhere in the wind, and almost everywhere, outside of cities, in the currents of rivers and in the tides. When it has once become possible to cheaply store this power away in storage batteries in the form of electricity, the light problem for most localities will not be far from solution, regardless of petroleum. Again, some progress has already been made toward solving the great problem of obtaining electricity directly from heat. It is not yet possible to do so with any approach to reasonable economy, nor has science as yet indicated any hopeful direction for seeking such a result, but it is already possible to obtain very considerable amounts of electricity from heat otherwise wasted, and there seems reasonable ground for believing that this will be done in a practical way ere long in connection with storage batteries. Thus the means exist in abundance for the cheap generation of electricity for light. All that is needed is still better processes for storing and using it. Such great progress has been made in this direction during the past year or two that there is but little more to accomplish before petroleum will cease to be indispensable for lighting isolated houses. It may be that this little will not be accomplished until petroleum becomes much dearer, but that it will not be accomplished then is hardly supposable from the present state of science.

For these reasons we may look with some approach to equanimity on the possibility of the disappearance of both our natural oil and natural gas supply: Their death may even prove as useful as their life.

PERSONAL.

R. C. WILLIAMS, C. E., engaged on the Tennessee Midland Ry., was struck by lightning and killed at Linden, Tenn., April 2.

ROBERT B. STANTON and H. F. MERIWEATHER have entered into a partnership for general engineering work with offices in Barclay Block, Denver, Col.

T. S. CALKINS, M. Am. Soc. C. E., has recently completed plans for a system of sewers for the village of New Rochelle, N. Y.

Gen. QUINCY A. GILLMORE, U. S. A., died in Brooklyn, N. Y., at the age of 63. He graduated at West Point in 1849 and was assigned to the Engineer Corps. He served as assistant engineer in the construction of Forts Monroe and Calhoun, at Hampton Roads, Va., and from 1857 to 1859 was in charge of the fortifications of New York harbor. He saw considerable service during the war, and was commander of the Federal troops and chief engineer of the siege at Fort Pulaski, Ga., the reduction of which was one of his greatest works. For this he was appointed brevet Lieutenant Colonel. In 1864 he conducted the operations against Charleston, S. C. In February, 1865, he was given command of the Department of the South with the brevet title of Brigadier General and subsequently Major General, which commission he resigned December 5, 1865. For the succeeding ten years he was assigned to many very important engineering commissions, such as testing the use of iron in fortifications and the availability of Gatling guns, and reporting on the feasibility of a ship canal to connect the Mississippi river with the Gulf of Mexico. By executive appointment he was president of the Mississippi River Commission. At the time of his death he was in charge of Government work on the Atlantic coast between New York and Florida.

He was the author of "The Siege and Reduction of Fort Pulaski," "The Engineer and Artillery Operations against the Defences of Charleston," "Treatise on Limes, Hydraulic Cements and Mortars," "Treatise on the Construction of Roads, Streets and Pavements," and "Report on the Strength of Building Stones in the United States."

Reports of State Railway Commissions.

KANSAS.

The fifth annual report of the Kansas Board of Railroad Commissioners for the year ending June 30, 1887, just received, is a well printed volume of 448 pages. We conclude that the report is really intended to be for the fiscal year above given, as it is so stated in the body of the report, but the title page of the book states that the report is for the year ending Dec. 1, 1887, and parts of the report seem to be compiled under this supposition. The very commendable suggestion is made by the Commission that the fiscal year be made to conform to that established by State and United States Statutes. The railway companies, however, can hardly be expected to make any attempt in this direction until some uniformity is brought about in the fiscal years of the States and the Federal Government. A railway company doing business in half a dozen different States may be asked to make statements of the results of its operations in each State for as many different fiscal years, and an additional one to the Inter-State Commerce Commission. This would necessitate much needless labor. Under the present state of affairs it is almost impossible to collect very accurate statistics of railway operations over areas including several States. What particular date should be chosen as the beginning and end of the fiscal year is a less important matter, but it certainly seems that the practice of making the fiscal year coincide with the calendar year is growing more prevalent. A change from a fiscal year already established might cause some embarrassment; but once fixed, there could hardly be a better date for summarizing the results of operations than January 1. Construction of all sorts is generally at a stand still, traffic is not especially active, and the extra work which may be required from clerks and bookkeepers is much less wearying than in the extremely hot weather of early summer.

The Report contains extended comments on the enormous amount of railway construction which has gone on in Kansas during the past two years. The records of the total total mileage of the State at the end of the various fiscal years are as follows:

Year ending June 30.	Miles.
1883	4,350.39
1884	4,574.76
1885	4,750.71
1886	5,357.72
1887	7,348.36

"Most of the new roads built in the State the past two years have been built in a very substantial manner, and with a view to their future economical operation."

The Commission condense their report regarding the safe condition of the various old roads in the State within the limits of a page. Evidently the inspection which they state has been made "from time to time as opportunity has afforded" has not been regarded as an especially important branch of their work.

The condensed statement of the results of operations is as follows:

Gross earnings, 1887	$71,694,474
" " 1886	62,768,858
Increase	8,925,616
Net earnings, 1887	31,256,869
" " 1886	30,324,444
Increase	932 425
Total tonnage, 1887	21,293,842
" " 1886	16,436,575
Increase	4,857.257
Capital stock, 1887	325,482,967
" " 1886	284,044 892
Increase	41,438,075
Average rate of dividend, 1886	2.47 per cent.
" " 1887	2.41 " "

Nearly a third of the report is taken up by a record of the complaints made to the Commission with the respondents' answer and the final decisions. Many of the complaints are laughable from their trivial importance, and it may certainly be questioned whether the time of a State Railway Commission and of Railway Managers should be taken up by long disputes over a ten cent overcharge on a lot of old trunks (as happened in one case), at the will of any malicious or ignorant individual. It is noticeable that many of the complaints were made to the Commission before any notice of grievance was given to the railroad company. It is also notable that there are very few, if any instances in which the railroad company seems to have been actually guilty of discrimination or extortion. The last half of the report gives the reports from the various companies, and while some space is devoted to tabulated comparisons of these figures, much more could be given with profit.

In their work the Commissioners have generally shown a just appreciation of their position as judges in equity and of the true principles of State railway control. In this respect they are in advance of a popular sentiment in the State which would force railway construction by permitting heavy bonding by towns and cities, and demands "competing lines" for the purpose of fostering a feverish activity in real estate. The Commissioners most truthfully say: "It is not wise, neither is it conducive to any permanent or substantial interest either of the public or of the railroads, to construct two or more lines parallel and so near each other as to divide a local business insufficient for one. The people who from such a conjunction of affairs expect competition are deluded, and the men who venture their money in such an enterprise are equally 'left.' Wisdom is supposed to come from experience, but it takes an awful amount of the latter from which to derive even a modicum of the former."

THE Birmingham Ship Canal project seems in a fair way of going ahead, and some curious statements of the high freight rates in England on coarse freight have been brought out in consequence. It is estimated that on the average English iron and steelmasters pay 114 per cent. more for the carriage of iron and steel than do those of France, and 112 per cent. more than Germany. Again: heavy machinery is charged 20s. per ton from Birmingham to London; but it is shipped to Australia, a distance of 11,000 miles, at 7s. 6d. per ton. Some Birmingham merchants, who last year exported undamageable iron rails and other manufactures to Melbourne, paid carriage to London at the rate of 12s. or 12s. 6d. per ton, whereas the cost of conveyance from London to Melbourne was considerably less than 5s. per ton. The iron of South Staffordshire pays a freight of 15s. to London, or 10s. to Liverpool.

CORRESPONDENCE.

County Maps.

ASHEVILLE, N. C., April 11, 1888.

EDITOR ENGINEERING NEWS:

I want two or three county maps. Where can get them? My object in wanting these maps is to get a sample to accompany a proposition submitted for the making of a map of this county.

J. G. ASTON, *City Engineer.*

Effect of Sea Water on Iron Piles.

NEWPORT, R. I., March 20, 1888.

EDITOR ENGINEERING NEWS:

In connection with the effect of sea-water on iron piles, some reference to a paper which I read before the Engineers' Club of Philadelphia has been made.

In relation to the rates of corrosion above and below the surface of the water and between high and low water, my examination of the iron indicated that the action causing the deteriorations under water was entirely different from that in the air, for the reason that the product was different. In the case of the wrought-iron the coating of rust (?) found under water had the appearance of a soft black deposit, easily removed, leaving a bright metallic surface to the iron, with sharp edges between the lines of greatest corrosion. This black deposit on exposure to the air was converted into a brownish mass similar in appearance to the rust usually seen on iron corroded under atmospheric influence alone. The appearance of the rods above the surface of the water, after the removal of a thick coating of rust, showed a tendency to reduce the original circular section to that of an irregular polygon with rounded corners and an entire absence of the longitudinal seaming, so prominent a feature of the corrosion under water.

This deterioration in longitudinal lines took place most rapidly on the two opposite sides of a bar, while at the extremities of a diameter at right angles to the one joining the lines of greatest destruction the surface of the bar was comparatively smooth. From this, and the occurrence of deep holes at isolated spots, I offered as a possible explanation that the seaming might occur along the lines which would represent the edges of the plates forming the pile from which the bar was rolled. The bar thus being composed of layers varying somewhat in chemical characteristics, and possibly in galvanic properties, was in a condition to deteriorate most rapidly along those lines, while at the extremity of the other diameter the surface exposed would be that of a single plate of the original pile. And wherever the deep

holes occurred it merely represented a greater concentration of the necessary elements of destruction.

If there is an entire difference between the two actions above and below the surface of the water, which it seems to me is beyond doubt, that portion of the iron exposed between high and low water must be subject to the alternate action of the two and the destruction may in the aggregate be greater than either of them, but it takes place with a certain degree of uniformity over the entire surface; and if, as Mr. A. S. COOPER states in your issue of March 17, he finds that a coating of shells, etc., sometimes protects the pile between high and low water it would indicate that the atmospheric action was prevented thereby and the subaqueous action occurred only at intervals. But below the surface the action would be in constant progress in one line or around one spot, and in time would materially reduce the cross section. As the strength of the pile is limited by its least section it would seem that below the surface would be the place to expect the greatest danger.

The Brandywine light-house was the first iron screw pile structure built in the United States, and affords an excellent opportunity for a study of the effect of sea water on iron, but unfortunately in the prosecution of every day work there seems to be but little time to devote to the careful study of such matters.

The examination of the light house which resulted in the paper referred to was not made with a view to determining the effect of sea water on iron, but the observations recorded in the paper were merely incidental to the other work, and were contributed as a slight addition to the very scanty information I was able to find on the subject.

Very respectfully,

EDWARD PARRISH.

A Riveted Bridge in a Collision.

ALBANY, N. Y., March, 31, 1888.

EDITOR ENGINEERING NEWS:

I am glad to see from recent issues that ENGINEERING NEWS is getting around to my way of thinking concerning riveted bridges, and by way of further evidence I beg to submit the enclosed view showing how such a bridge acts under difficulties as compared with pin-connected trusses of which I have occasionally given you examples.

The photograph is not a recent one. It represents the result of an accident which happened on Aug. 24, 1873, to the bridge over the Seneca river on the Auburn branch of the New York Central & Hudson River R. R. The bridge was struck by a derailed freight train which damaged one truss very badly and the other to some extent. Unfortunately the view was not taken until the bridge had been partly shored up by false-work, so that the full effect is not gained. You will note that the end post is broken *entirely in two* and several web members so badly bent as to be worthless, still the bridge did not go down. I think you will agree with me that no pin connected bridge ever built could possibly stand this racket.

Regarding the Hondo creek accident on the Southern Pacific railroad on March 1, the facts are these: A stick of bridge timber 12 ins. square by 16 ft. long fell from a passing train and struck the bridge knocking one of the end posts out of place but not causing the truss to fall at once. Soon afterward another train ran on the bridge when it gave way and dropped the train into the creek, killing two trainmen and injuring two more. The bridge had Phœnix column posts and was built by Clarke, Reeves & Co.

Yours truly,

CHAS. F. STOWELL.

Effect of Collision on a Riveted Bridge.

What is "Topography?"

WASHINGTON, D. C., March 28, 1888.

EDITOR ENGINEERING NEWS:

Permit me to correct a misapprehension of which I have been made the victim in recent issues of your journal.

On March 3, you saw fit to publish a fragment from a letter of mine in reply to your recent call for corrections to WELLINGTON'S "Economic Theory of Railway Location," and in doing so put me on record as stating, in effect, that under average conditions a topograher can map from 8 to 10 miles of topography per day, as opposed to a statement in the work in question (p. 884) placing the limit at from 1 to 2 miles per day. [This statement is inaccurate. It is stated on p. 884 merely that after being once "properly instructed it is *not at all difficult* to take a mile or two of topography a day in ordinary country."—ED.]

In thus isolating a statement from a letter not intended for publication, there was rendered obscure what I had in mind to bring out, that Mr. WELLINGTON'S estimate was to be regarded rather as lying near the minimum, to which mine was the maximum, corresponding to the range of conditions with which the topographer may have to deal.

In your issue of March 24, Mr. LUTZ, laboring under this misapprehension, ironically accuses me of supernatural ability.

It is to be hoped that Mr. LUTZ'S topography will stand criticism better than his dogmatic assertions; and it might be further suggested that the great extent of the western United States, over which railroads have been so recently extended, offers in its topographic diversity (ranging from the almost Alpine type of the Sierras on the one hand, to the flat type of the Plains and the Great Basin deserts on the other), a diversity of conditions hardly to be duplicated about Annapolis, a diversity which necessarily places the estimate of what a topographer can do in a day between such wide limits as from one to ten miles.

Furthermore, it might be urged that the quantity of topography that may be "taken" per day will depend somewhat upon what is comprehended under the term "topography."

There is clearly observable of late a nearly universal tendency to restrict the application of the term entirely to surface form—to the relief. Many, however, still include other natural features such as drainage and timber outlines. A still more limited class go so far as to include also the artificial or cultural features.

For example, in "The New South", by M. B. HILLARD, 1887, p. 96, in an article on the "Topography of West Virginia," Prof. WM. FONTAINE, Univ. W. Va., says:

"In order to understand the topography of the country we must know its geology, for the rocks which underlie the soil form the materials out of which the surface features have been carved, and their varying hardness and proneness to disintegrate will determine the changes finally assumed."

In the standard treatise on roads by Gen. GILLMORE of the U. S. Eng. Corps, this occurs:

"In laying out important roads, and especially in locating streets, in thickly settled districts, it is well to place contour curves upon the map. These curves indicate at once, to the practised eye, the topography of the country they embrace."

Maj. D. P. HEAP, U. S. Engrs., answers certain questions put to him, as follows:

Q.—"What is that quality in a *topographic* map which distinguishes it from other maps?"

A.—"The principal quality is that of depicting graphically the relief: a *secondary* quality is the showing by conventional signs, of the natural features of the surface whether land or water, wooded, cultivated, marshy, etc. This would omit roads, railways, houses, etc."

Q.—"What is topography?"

A.—"The science of exact delineation as described above."

Yours truly, EUGENE RICKSECKER.

[Any communications to the editors commenting in a general way on technical questions, especially when discussing or questioning past statements of the editors, is supposed to be for publication if there is nothing to indicate or imply the contrary. Our correspondent's letter was given in full, excluding only one or two typographical corrections, having no relation to the rest of it, and we certainly supposed from its form that it was intended for publication.

As to what "topography" is, the word has a natural and unavoidable double meaning according to the connection, like most other words in the English language, and we know of no better definition than that on page 873 to which our correspondent originally took exception, viz:

"Topography, in the limited technical sense of the word which is given to it in railway location, is the representation upon a map by 'contour lines' of the comparative or absolute elevations on the area covered by the map. In a broader and more literally correct sense, it includes the representation of all the details of the surface by any method whatever, including form, character, and artificial structures."

Both of these uses of the word are needed and neither can well be dispensed with, or met by coining a new word unnecessarily.—ED. ENG. NEWS.]

PUBLICATIONS RECEIVED.

Recent Improvements in the Art of Signalling for Military and Commercial Purposes. The Finley Helio-Telegraph and its Modifications, etc. Published by the American Helio-Telegraph and Signal Light Company. Second Edition. Washington, D. C., 1888. Paper covers, 4½ × 7¼ ins. 207 pp. 17 cents. A further notice of this book will appear later in these columns.

The Fifth Annual Report of the Board of Railroad Commissioners, State of Kansas. For the year ending Dec. 1, 1887, 6½ × 9 in., 448 pp. cloth bound. Published by the State. We give a review of this volume under the usual head of State Railway Commission reports.

Geological Survey of New Jersey. Being the Annual Report of the State Geologist for the year 1887. The John L. Murphy Publishing Co., Printers, Trenton, N. J., 1887. This pamphlet of 45 pp. is accompanied with a fine large map of the state of N. J. from original surveys based on the triangulation of the U. S. Coast and Geodetic Survey. Further notice will be found elsewhere in this issue.

The Lakes and Gulf Waterway. A brief, with illustrations and notes, published by the Citizens Association of Chicago, and prepared under the direction of the Committee on Drainage. By L. E. COOLEY, C. E. Chi-

cago, 1888. This pamphlet of 4 × 6 ins. contains 83 pp., including appendices and cuts. A full review will be found elsewhere in this issue.

Report of the State Board of Health of Massachusetts on Water Supply and Sewerage. Boston, Mass. January, 1888.

The above is a valuable and interesting report, published in the form of a 95 page pamphlet. The work of the Board may be divided into three departments: 1, advising cities, corporations, etc., in regard to water supply and sewage disposal; 2, obtaining information in regard to existing sources of domestic water supply and subjecting samples to analysis; 3, collecting information in regard to experiments made upon the purification of sewage by applying it to land, and conducting additional experiments. In the first department there have been 25 applications; 11 on water supply, 11 on sewerage, 2 on pollutions of streams and 1 on disposal of manufacturing refuse. The report contains particulars of all the above cases. In the second department much information has been gathered and tabulated relating to the Taunton, Charles, Blackstone and Merrimac rivers, and their tributaries. In the 30 pages devoted to the land disposal of sewage there is much useful information. Appended to the report of the Board are the reports of F. P. STEARNS, Chief Engineer, and G. H. PARKER, Biologist.

South Pittsburg on the Tennessee River, Marion County, Tennessee. A Brief Sketch of its Location, History, etc. South Pittsburg, Tenn., 1887.

This pamphlet of 32 pages, contains 13 cuts illustrative of the city, and is intended to show the natural and acquired advantages of South Pittsburg, with a view to attract capitalists. The places owes its early growth and prosperity largely to the Tennessee Coal, Iron & Railroad Company, while since 1886 the South Pittsburg City Company has done much for the place. South Pittsburg is the manufacturing center of the rich Sequachee Valley, notice of which is given below. An ample supply of good water has been provided during the past year. Railroad connections are provided by the Nashville, Chattanooga & St. Louis, the Memphis & Charleston, and the East Tennessee, Virginia & Georgia Railways.

Hand Book to the Sequachee Valley, Tennessee. By WM. M. BOWRON, Mem. Am. Asso. of M. E., etc. Price 10 cents. Nashville, Tenn., Foster & Webb, Printers, 1888.

This pamphlet of 26 pages has a diagram showing the geographical formation of the Cumberland Mountains at this point, and is supplemented by a small map of the Sequachee Valley. It describes the natural resources of the valley, and tells how these have been and may be developed. Among these natural resources we may mention here: a large variety of timber, sand for glass-making, clay for terra-cotta pipe and fire brick, iron, coal, and limestone. As stated above, South Pittsburg is the manufacturing center of the valley.

SOCIETY PROCEEDINGS.

Engineers' Club of Philadelphia. — Meeting of March 17. Mr. A. MABICHAL read a paper upon the "Testing of Cements," calling the attention of the Club to the waste of money resulting from the incomplete knowledge of the properties of cements. "Some engineers spend many hundred dollars to test their cement; yet the mortar used in their works is not worth a penny."

The author noted the following points:

1. If masonry work is made under contract, the specifications should state the required properties of the mortar and *not of the cement.* A cement may give splendid results when tested neat, and yet the mortar may be of the poorest kind. *Tests of pure cement alone are entirely useless.*

2. When the object is to determine the relative value of different brands of cement, tests should be made with different proportions of sand in order to ascertain which is the *most economical* cement.

3. These tests should be made under similar conditions: the temperature, the manipulation, the quality of and the speed of uniformity in applying the load, etc., are all important factors. *They should be constant;* otherwise the results will not be reliable.

4. The compressive strength is of the greatest importance in ordinary construction; unfortunately it cannot be ascertained with any degree of accuracy. The cement is *injured before it is crushed.*

5. It was observed that an expansion of 4 per cent. was taking place in a cement pavement: it was due to the hydration of magnesia contained in excess in the cement. Some mortar should be placed in a glass tube and some water poured on top; if the glass breaks, the cement is *unfit for work exposed to dampness,* and should be analyzed.

"I have summarized the properties of cement which, I thought, were of practical use to engineers in charge of masonry work, with a view of avoiding any waste of money in so-called tests of no value whatever. Every year appropriations are made for public works all over the country; the percentage used for cement represents an immense capital, and should be spent in the most beneficial manner. Good cement should be bought, good mortar should be made with it."

Mr. MABICHAL asked for the appointment of a committee of five who would recommend a *practical method of testing cements* and present it to the club for its approval, which, on motion, was ordered.

Mr. FREDERICK H. ROBINSON presented a complete description of the Manufacture of Gunpowder.

Mr. L. F. RONDINELLA presented a paper upon Incandescent Electric Lighting, giving tables, formulæ and calculations, for the determination of the relative commercial values of lamps of higher efficiency and shorter life, with those of lower efficiency and longer life.

Engineers' Club of St. Louis.—The club met at Washington University at 8:15 P.M. April 4. President HOLMAN in the chair, twenty-four members and four visitors present. RUSSELL PARKER was elected to membership.

The special committee on resolutions appropriate to the death of FREDERICK SHICKLE reported as follows:

Resolved, That, by the death of FREDERICK SHICKLE, the Engineers' Club of St. Louis has lost a most valuable member, one who has been with us from the beginning as a charter member, and whose zeal and life have been devoted to engineering pursuits—a man endeared to his fellow men by his kind and genial bearing and his ever courteous and upright conduct.

Resolved, That we extend to his bereaved family our profound sympathy, and

Resolved, That a copy of these resolutions be suitably prepared and presented to the family of our lamented associate.

T. A. MEYSENBURG,
WM. WISE,
Committee.

On motion the report of the committee was adopted. The president presented a communication from L. E. COOLEY, president of the Council of Engineering Societies on National Public Works on the subject of the Reorganization of National Public Works. On motion it was made the special order for the next meeting, April 18th.

The secretary then read a paper on "Railroad Location; Field Practice in the West," by WILLARD BEAHAN. The author explained the difficulties to be overcome, and the most common methods employed. He also gave his own method, which he had used largely, with very satisfactory results. The paper was discussed by Prof. JOHNSON and Messrs. WHEELER, SEDDON, MOORE, BOUTON and CLARK. There was considerable diversity of opinion as to the best method to follow, which in every case must depend upon the character of the country to be traversed.

Prof. NIPHER explained to the club a calorimeter he had prepared for the purpose of determining the heat value of fuels. It was a quick method and gave accurate results. The apparatus was shown and a test made. After some general discussion of Western fuels, the meeting adjourned.

W. H. BRYAN, Secretary.

American Society of Mechanical Engineers—The 17th meeting of the Society will convene at Nashville, Tenn., on Tuesday, May 8, at 8 P. M., and will adjourn on Friday, May 11. The headquarters and the secretary's office will be in the Maxwell House, corner of Church and Cherry Sts., and it is urged that as many as possible stay at the same house, for the sake of social and professional advantages.

The following papers are to be presented in the sessions and discussed:

J. S. COON: "Duty Trials of Pumping Engines."
JAY M. WHITHAM: "Surface Condensers."
R. H. THURSTON: "Large and Enlarged Photographs and Blue Prints."
R. H. THURSTON: "Proportioning Steam Cylinders."
JOHN T. HAWKINS: "Automatic Regulator for Heating Apparatus."
JOHN T. HAWKINS: "A Plea for the Printing Press in Mech. Engineering Schools."
C. C. COLLINS: "A New Method of Inserting and Securing Crank Pins."
GEO. L. FOWLER: "Estimating the Cost of Foundry Work."
HENRY R. TOWNE: "A Safety Car Heating System."
WM. F. MATTES: "Connecting Rods."
WM. J. BALDWIN: "Notes on Warming Railway Cars by Steam."
FRED. A. SCHEFFLER: "A Foundry Cupola Experience."
A. F. NAGLE: "The Best Form of Nozzles and Diverging Tubes."
JACOB REESE: "The Tetra-Basic Phosphate."
L. S. RANDOLPH: "Strains in Locomotive Boilers."
W. L. CLEMENT: "Steam Excavators."
GEO. H. BARRUS: "An Electric Speed Regulator."
GEO. H. BARRUS: "The Effect of Circulation in Steam Boilers on Quality of Steam."
GEO. H. BARRUS: "Memoranda on the Performance of a Compound Engine."
H. L. BINSSE: "A Short Way to Keep Time and Cost.
F. W. DEAN: "The Distribution of Steam in the Strong Locomotive."
JOHN M. SWERNEY: "River Practice of the West."
J. BURKITT WEBB: "A Persistent Form of Tooth."
WM. HEWITT: "Wire Rope Fastenings."
HARRY DE B. PARSONS: "The Lateral Curves of Fishes as Offering Resistance."
J. E. DENTON: "Mechanical Significance of Determination of Viscosity of Lubricants."

Subjects and queries will also be presented for the topical discussions, which have proved so interesting and profitable at the recent meetings. Special railroad rates have been secured under the certificate plan, for which full details will be given on application to the Secretary, F. R. HUTTON, 280 Broadway, New York City.

CONSTRUCTION NEWS.

RAILROADS.

East of Chicago.

Existing Roads.

Cincinnati, Hamilton & Dayton.—Work has just begun on the extension to, and union depot at Findlay, Ohio.

McKeesport & Bellevernon.—The locating survey is in progress opposite Monongahela City, Pa., and grading is to begin on that section soon.

New York & New England.—The contract has been let for the extension of the New Haven & Derby road, for which surveys were made last summer. The work is to be completed by Aug. 15.

Grand Rapids & Indiana.—A survey has been made and local aid is being secured for an extension from Portland to Camden, Ind.

Baltimore & Drum Point.—A new survey is in progress for this Maryland road, from Lothian, Anne Arundel county, to Federal Oaks, Calvert county.

Kingston & Pembroke.—Chief Engineer T. W. NASH has made a reconnoissance for the proposed extension from Sharbot Lake to Appleton. The distance is about 42 miles.

South Pennsylvania.—Rumors of the early resumption of work on this line are again in circulation.

Zanesville & Ohio River.—Tracklaying is completed to Coal Run on the southern extension of this Ohio road.

Bloomsburgh & Sullivan.—It is reported that this Pennsylvania company will let contracts soon for a bridge across the Susquehanna river at Bloomsburgh, Pa., at a cost of forty to fifty thousand dollars, and an extension from Central, the present terminus, to Berenice, where connection will be made with the State Line & Sullivan Railway, and a heavy coal traffic may be secured.

Waterloo & Magog.—This line in the province of Quebec has been sold to the Canadian Pacific and will form part of the proposed short route to the coast.

Michigan Central.—Work is to begin this month on the proposed belt and transfer line at Detroit.

Western Maryland.—The engineers of this company have just finished the relocation of the old "Tapeworm Railroad" partly graded many years ago. The line is about 15 miles in length and it is reported will be built this season.

New Projects and Surveys.

Vaudreuil & Prescott.—J. B. A. MONGENAIS has been elected President, and ALBERT HAGAR, Vice-President, of this Quebec company.

Manchester & Portland.—The survey for the railroad proposed between these Connecticut towns has been completed and a feasible route has been obtained, with grades of 46 ft. to the mile. The line will connect with the New York, New Haven & Hartford Air Line division at Cobalt.

Barre & Williamstown.—A railroad company has been organized at Barre, Vt., to build a short line from Barre to Williamstown. D. R. SORTWELL, President of the Montpelier & Wells River Valley R. R., is at the head of this enterprise.

West End.—This company has been organized at Lancaster, Pa., to build a short railroad. JOHN C. HAGER is President. JOHN F. REED is Secretary and Treasurer.

Montreal Island.—A bill is before the Dominion Parliament to incorporate this company to build a railway from Montreal to Maisonneuve, Longue Pointe, Pointe Aux Trembles, St. Laurent and Lachine. VICTOR HUDON, J. C. AUGER, F. W. HENSHAW, J. M. ÉMARD and others of Montreal are interested.

Buffalo & Williamsville.—The contract for building this road, eight miles in length, near Buffalo, N. Y. has been let to J. E. MCINTYRE, and work is to begin at once.

Indianapolis & Southwestern.—This company has been incorporated to build a railroad from Indianapolis to the Wabash river, in Sullivan county. W. A. ALLEY and P. H. BLUE, of Chicago, President and General Manager of the Indiana & Illinois Southern R. R., are interested.

St. Lawrence & Adirondack.—A bill has passed the Dominion Parliament incorporating this company to build a railroad from Valleyfield, Beauharnois county, Que., to the International boundary.

Sandusky, Ashland & Coshocton.—It is announced that work will begin on this Ohio road during the present month.

SOUTHERN

Existing Roads

Richmond & West Point Terminal.—ALFRED SULLY has resigned the Presidency of this company, stating that he is not in harmony with the present board of directors. The present management have issued a circular defending their administration. The stockholders' committee who are making the fight against the present directorate are said to be heavily interested in the Central R. R. of Georgia and the Norfolk & Western.

Nashville & Knoxville.—Grading is making rapid progress on this line in Wilson County, Tenn. The point at which the line will cross Caney Fork has not yet been determined. A special meeting of the stockholders is to be held at Lebanon, Tenn., on April 25, to vote upon the issue of bonds by the company. JOHN CRAWFORD, of Lebanon, is Secretary.

Chattanooga, Rome & Columbus.—Track has been laid from Chattanooga, Tenn., south about 20 miles. About 4,000 men are now at work on the line.

Alabama, Florida & Atlantic.—It is reported that this Florida enterprise has been consolidated with the Florida Midland. The extension of the latter company will be completed to Kissimmee by June 1.

Pensacola & Memphis.—This Florida company has been reorganized with the following officers: President, A. M. JOHNSTON, Cleveland, O.; General Manager, W. W. HUNGERFORD, Meridian, Miss.; Chief Engineer, J. W. GALLUP, Meridian, Miss.

Tennessee Midland.—The surveyors are at work near Centreville, Tenn. The City Council of Memphis have granted the company right of way into the city. The depot will be located in the southern part of the city.

Atlantic Coast Line.—The Augusta extension is to be in operation from Sumter to Orangeburg by June 1. About 16 miles are now ready for tracklaying.

Tennessee & Coosa River.—The city of Huntsville, Ala., has raised $85,000 subscription to the capital stock of this company, and the work is to be pushed at once.

Covington & Macon.—The tracklayers have reached Madison, Ga., and grading is being pushed all along the line between Madison & Athens.

Cumberland Valley.—The survey has been completed for the Martinsburgh & Potomac extension from Martinsburgh to Winchester, 24 miles, and contracts are to be let at once.

Roanoke & Southern.—The company has asked the City Council of Roanoke, Va., to execute the bond for $100,000 voted by the city. Work is to begin on the grading April 16.

Kanawha & Ohio.—The engineers are locating the extension from Charleston, W. Va., east, and the contract has been let for the grading.

Wilmington Sea Coast.—Tracklaying began on this road April 10.

Norfolk & Western.—It is reported that the company intends to begin work this season on the Virginia & Ohio Railroad, which has been surveyed through West Virginia to Ironton, O. It is more likely, however, that nothing will be done until the completion of the Clinch river extension.

New Projects and Surveys.

Nashville.—Several schemes for dummy lines are reported at Nashville, Tenn. The Belmont & Harpeth River is to be about 9½ miles in length. JAS. C. BRADFORD is President, and LOUIS T. BAXTER is Secretary and Treasurer. A charter has been asked for the Lischey Avenue & National Cemetery Railroad, by C. T. SHARPE, M. T. BRYAN, and others. The line would be about 5¼ miles long. The High Street, Mount Olivet & Upper Island Dummy road has been granted a right of way.

Memphis, Tuskaloosa & Atlantic.—This company has been incorporated in Alabama to build a railroad from Columbus, Miss., to Woodstock, Ala. W. C. JEMISON, G. A. SEARCY and others are among the incorporators.

Cartersville & Gainesville.—A reconnoisance is in progress for a railroad between these Georgia towns.

THE NORTHWEST.

Existing Roads.

Chicago, Santa Fé & California.—The through line between Kansas City and Chicago is to be opened for business on May 1. The line might have been opened some months ago but the rate war and the strikes have thus far prevented any probability of the line paying its expenses, and rather than be drawn into the strife with the other Northwestern lines the Santa Fé managers have wisely postponed the opening of their new line.

Sault Ste. Marie & Southwestern.—A survey has been made from Fairchild, Wis., to a point opposite Winona, Minn., and it is proposed to consolidate the enterprise with the Winona & Southwestern project.

Chicago, Burlington & Quincy.—The statement of the company for the months of January and February shows the severe losses occasioned by the rate war as follows:

	Gross earnings.	*Expenses.*	*Net earnings.*
Feb., 1887	$1,847,234.76	$ 984,845.02	$ 862 389.74
Feb., 1888	1,686,519,08	1,198 272.43	488.246.65
Increase		$ 213,427.41	
Decrease	$ 160,715.68		$ 374.143.09
Two months ending—			
Feb. 28, 1887	$3,832,619.77	$2,049,988 05	$1,782,631.72
Feb. 29, 1888	3,357,812.81	2,490 923.70	866,989.11
Increase		$ 440,935.65	
Decrease	$ 474.806,96		$ 915,742.61

The strike did not begin till near March 1, and the above loss, therefore, is due solely to the rate war. The March report, not yet issued, it is estimated will show a total decrease of $1,500,000.

Lake Erie & Western.—It is expected that the deep cut on the Peoria extension will be completed so that connection can be made between the two ends of track by the middle of April. The annual report gives the following figures:

	1886	1887	Increase.
Gross earnings,	$1,659,493	$1,899,313	$239,820
Expenses,	1.329,434	1.152.307	Decrease, 177,127
Net earnings,	$330.059	$747,006	$416,947

Minneapolis, Sault Ste. Marie & Atlantic.—General Manager UNDERWOOD is soliciting bids for the construction of 2,000 new freight cars.

Illinois Central.—Plans are in preparation for a union depot at Decatur, Ill., to cost about $100,000. The construction of the Chicago, Madison & Northern Railroad from Salt Creek, Ill., east toward Chicago ten miles has begun and will be rapidly pushed. Work is generally light. There is one bridge to be built over the Desplaines river 180 ft. in length.

Red River Valley.—Premier GREENWAY states that this road will be completed to Winnipeg by July 1. It is to be built by the Government, and different companies will be given trackage rights over it. The extension from Winnipeg to Portage will be built, but it is not yet decided whether it will be done by the Government or by a chartered company.

New Projects and Surveys.

Aberdeen, Sioux Falls & Montana.—

ABERDEEN, Dak., April 4, 1888.

EDITOR ENGINEERING NEWS:

I send you enclosed map showing as near as possible the route of our line. Our engineer is on the line now and surveyors will be out in ten days. The enterprise is projected in the interest of Aberdeen. R. E. KIRK, is Chief Engineer. C. A. JEWETT, *President.*

Canada, La Crosse & Southwestern.—This company whose very extensive project was noted on our Northwestern map, seems to have made no move as yet toward building its proposed line. A press report from Black River Falls, Wis., however, says that the President of the company has stated his intention of building on the line surveyed by the Milwaukee, Lake Shore & Western from Wausau to La Crosse, if the latter company does not conclude to use its survey.

Wisconsin Midland.—At a recent meeting of the directors, a survey was authorized from Fond Du Lac to Madison. The vacancy caused by the death of the President, Hon. A. G. RUGGLES, was filled by the election of C. B. BARTLETT.

Duluth Terminal.—A new ordinance has been drawn in reference to the franchises of the Duluth Terminal Company.

Chinook Belt & Peace River.—A charter is to be granted to this company to build a road from Calgary to Edmonton, N. W. T. This charter is inoperative, however, unless at the end of six months the Alberta company, which also has a charter over the same route, has not finished at least 50 miles of its line.

Winona & Southwestern.—This Minnesota company has been reorganized and has executed a mortgage for $8,000,000 to the Farmers Loan & Trust Co., of New York City. The men who have been pushing the enterprise in the interest of Winona have resigned, and their places have been taken by such men as JOHN I. BLAIR, of Blairstown, N. J., WILLIAM S. HALSTEAD, of Scranton, Pa., General Manager of the Delaware, Lackawanna & Western, P. B. WALKER, representing President SLOAN, of the Lackawanna, and Hon. WILLIAM WINDOM, of Minnesota, who was chosen President. A traffic agreement has been closed with the Green Bay, Winona & St. Paul Co., in which the Lackawanna syndicate are also heavily interested, and it is thought that the work of constructing the line from Winona to Mason City, Ia., and from Fort Dodge, Ia., to Omaha, Neb., will be undertaken at once.

Chicago, Paducah & New Orleans.—The directors of this Illinois company have elected CHAS. HENSEL, of Springfield, Ill., Resident Engineer, of the Wabash, Chief Engineer. WM. VANDERCOOK, has been appointed locating engineer, and the surveys are to be pushed forward at once.

THE SOUTHWEST.

Existing Roads.

St. Louis, Arkansas & Texas.—As announced in last week's issue, the last spike has been driven on the Fort Worth and Shreveport extensions and the third of the principal extensions of the company under way at the close of the year, the Little Rock & Eastern, has just reached Argenta on the Memphis & Little Rock road, over which line the Cotton Belt trains will enter the city for the present. The Chief Engineer of the Little Rock & Eastern, W. S. HAYWOOD, states that the reason the work, which was to have been completed by Dec. 1, has been so long delayed was the heavy rains during the winter months. The work on the line from Argenta to Little Rock will be rapidly advanced and it is reported also that the company has secured an interest in the proposed Little Rock & Hot Springs road, and will begin work on the line soon. The preliminary surveys for an extension from Gatesville *via* Lampasas to Llano have been completed.

Southern Pacific.—The locating surveys for the Victoria and Beeville extension are to be made at once. It is rumored with no great probability that the Southern Pacific is backing the project for a railroad from El Paso to White Oaks, N. M. The company is to build a 34 stall round-house at San Antonio, Tex., and will also add largely to the capacity of the repair shops at that point.

Cape Girardeau Southwestern.—The location is completed and contracts have been let on the extension from Wellsdale, Mo., to the junction with the Current River branch of the Kansas City, Fort Scott & Gulf system in Carter county.

Chicago, Rock Island & Pacific.—The company took possession of the Arkansas, Kansas & Colorado line from Dodge City to Bucline, Kan., on April 1. On the extension from Dodge City west, 15 miles are graded. A force of Rock Island surveyors under W. P. JONES is making surveys from Baird to Albany, Tex.

Missouri Pacific.—On the Kansas and Arkansas Valley line in Indian Territory, 20 miles of track are reported laid. Bids are being received for the bridge across the Arkansas river at Fort Smith for which the city voted a heavy subsidy last year. The Jefferson City, Booneville & Lexington line, in Missouri, has been opened for business from Lexington to Marshall, 50.4 miles. It is reported that the company is obtaining local aid for the construction of a line from Denton to Decatur, Tex., about 25 miles. Work is soon to be resumed on the Dallas & Hillsboro extension.

St. Joseph Lead Company.—The extension of this Missouri line from Bonne Terre toward Crystal City is making good progress. A bridge is under construction across Big river. T. T. ONDERDONK is General Superintendent of the Railroad.

Pine Bluff, Monroe & New Orleans.—Local aid is being raised for the proposed extension of this Arkansas road to Monroe, La. A survey is also in progress from Helena to Indian Bay.

New Projects and Surveys.

Kansas City, Rich Hill & Southern.—

RICH HILL, Mo., April 6, 1888.

EDITOR ENGINEERING NEWS:

The preliminary surveys have been completed from Kansas City to Rich Hill, Mo., about 80 miles, *via* Freeman, Burdette, Vinton and Mulberry. A large part of the right of way has been secured and arrangements are now being made to commence the permanent location of the line. The company is mostly composed of Kansas City capitalists who own and control the "Second Street Belt Railway" now being constructed, with which this line connects. S. F. SCOTT is President, T. S. CASE is Secretary and Treasurer, and S. P. KELLER is General Manager. The general offices are at 127 West Sixth St., Kansas City.

J. W. HEYLMUN, *Chief Engineer.*

Houston, Central Arkansas & Northern.—The city of Alexandria, La., has just voted a 5-mill tax for 10 years to this company. It is stated that the contract for building is to be let to W. J. REED. W. A. BRIGHT of Little Rock, Ark., is President.

Kansas City, Arkansas & New Orleans.—President GEO. M. BARBOUR of Beebe, Ark., states that two parties are now at work on the final location of this road and construction will begin by June 1.

Kansas, Odessa, Fort Stockton & San Antonio.—Incorporated in Kansas to build a road from some point in Bourbon county to some point in Harper county about 200 miles. JAS. HINDMAN, Zanesville, O., E. H. SABIN, San Antonio, Tex., WM. O. KULP, Davenport, Ia., S. A. JOHNSTON, Pittsburg, Pa., are among the incorporators.

Little Rock Bridge & Tunnel Co.—Incorporated at Little Rock, Ark., to build a bridge and a railroad about 3 miles in length. J. W. PHILLIPS of St. Louis is President, and JOHN C. ENGLAND of Little Rock is Secretary and Treasurer. The enterprise is said to be in the interest of the St. Louis Arkansas & Texas.

ROCKY MOUNTAIN & PACIFIC.

Existing Roads.

San Francisco, Clear Lake & Humboldt.—This California company has executed a mortgage to the Metropolitan Trust Co., of New York City, for $1,500,000. With the funds thus obtained, the road is to be built. This is the enterprise in which Gen. JOHN MCNULTA, Receiver of the Wabash, is interested. Engineers are reported at work on the final location and it is probable that contracts will be let soon.

Esquimault & Nanaimo.—The extension of this line on Vancouver Island into the City of Victoria was celebrated on March 29. A connection is soon to be established with the American system by a ferry across Beecher bay.

Southern Pacific.—The completion of the Sacramento & Placerville Railroad has just been celebrated. According to an interview with C. P. HUNTINGTON by a San Francisco *Call* reporter, the principal work of the year will be on the extension to San Diego and on the lines in Texas. A force is to begin work soon on the grading of the gap between Saugus and Templeton, and the lines in Humboldt county and up Stony creek are also likely to be built this year. A line is proposed for construction from Airlie to Newport, Oregon.

Seattle, Lake Shore & Eastern.—This Washington Territory company has been reorganized with the following officers: President, J. R. MCDONALD; Vice President, D. H. GILMAN; Manager, W. R. THORNELL; Secretary, GEO. G. LYON; Chief Engineer, P. F. MOHR. The Seattle & West Coast enterprise has been consolidated with this company, and it is reported that Thos. Earle & Co., the contractors, will push the grading at once from Seattle north to Snohomish and the connection with the Canadian Pacific.

Oregon Ry. & Navigation Co.—This company has just closed contracts for the building of 150 miles of extensions to Heppner, Eureka Flat and Lewiston.

Mexican Central.—The tracklayers on the Guadalajara extension have reached Atequiza 136 miles from Irapuato leaving but 25 miles to lay to reach Guadalajara. On the Tampico line over 2,000 men are at work and about 18 kilometers of track have been laid.

Park & Cliff House.—This 4 mile suburban road at San Francisco is nearly completed.

Chicago, Rock Island & Pacific.—The report is confirmed that this company is to enter Denver over the tracks of the Union Pacific from River Bend, Col., while the latter company will have a trackage right over the Rock Island line to Colorado Springs. The contracts for grading the extension have been let and work is to be pushed at once.

Rocky Fork & Cooke City.—SAMUEL WARD of Helena denies that the delay in the completion of this Montana line is due to the company. He states that contractor DENNIS RYAN failed to fulfill his contract and that the work will soon be let to other parties.

San Pedro, Los Angeles & Utah.—This California company is marketing a bond issue in the East.

New Projects and Surveys.

Tehuantepec.—A report from the City of Mexico states that the Government is considering a proposal for the completion of the railway across the Isthmus of Tehuantepec by an English syndicate.

Seattle & Green Lake Circle.—Incorporated in Washington Territory by C. C. CALKINS of Seattle and others, to build a short railroad.

Ilwaco Steam Navigation Co.—This short line at Ilwaco, W. T., is under construction. F. E. HABERSHAM of the firm of Hawgood & Habersham, Portland, Ore., is Chief Engineer.

Puyallup Valley.—Incorporated in Washington Territory by C. O. BEAN and GEO. W. MCALLISTER, of Tacoma, and others, to build a narrow gauge railway from Tacoma to Sumner, about 13 miles.

Helena & Hailey.—The Helena, Montana, *Herald* calls for the construction of a railroad to connect that city with the Wood river mining country. It is stated that in the 14 months ending last December, the Wood river mines shipped 29,831,707 lbs. of ore to the smelters. The ore at present goes over the Union Pacific lines, principally to Utah and Colorado.

Reducing the above sum to car loads we find the total output to be about four car loads per day. This is hardly a heavy traffic for a single line, and how it justifies the building of a competing road 250 miles in length through a most difficult country, we are at a loss to understand. The need of the Wood river mining country, if we are rightly informed, is not so much competing roads as it is a number of branch lines from the Utah & Northern and the Wood river branch to the various mines, obviating the present team haul to the railroad. It is to be hoped that the Union Pacific will soon be in a condition to undertake such extensions as these,

Contracting.

Sewerage and Plumbing.—The following proposals have been received by Col. F. L. GUENTHER, U.S.A., Little Rock barracks, Ark.: Little Rock Plumbing Co., $3,920 for sewerage and $220 for plumbing; Geo. P. C. Rumbough, $3,870.44, $259; Wells & Dungan, $3,792.86, $237; Ascher & Pray $4,000, $160; M. L. Reaves, $3,750, $215; Davey Clough $3,704, no bid. The contract for sewerage was awarded to D. Clough. The contract for plumbing was awarded to Ascher & Pray, who have also a plumbing contract for $300, making a total of $460.

Sewer Pipe.—The following proposals for 1,000 ft. of 8-in. salt vitrified sewer pipe, with 15 8 × 8 in. Ys, have been received by J. S. VERNER, Secretary of the State House Commission, Columbia, S. C.: Montague & Co., 16 cts. for pipe, 64 cts. for Ys; A. D. Palmer, 25 cts., $1; J. Watson, 25 cts., $1; John Alexander, 26 cts., $1.05; J. A. Purcell, 27 cts., 63 cts.; Agnew & Son, 20 cts., $1; J. C. Stanley & Bro., pipe and Ys, $274; J. V. Vrooman & Son, $274.03; Stevens Bros., $165. The contract was awarded to J. C. Stanley & Bro.

City Improvements.—*Baltimore, Md.*—A bill has been passed authorizing the issue of bonds for $5,000,000 for street improvements, sewers, etc.

Clifton, O.—The town will issue bonds for $100,000 for sewers and street work.

Martinez, Cal.—The city has voted to issue bonds for $30,000 for improvements.

Water-Works.—The following proposals have been received by the Louisville Water Co., Louisville, Ky.: Pumping machinery and boilers, complete, to be operated for a year to the satisfaction of the company: J. P. Morris Co., Philadelphia, $235,000; Quintard Iron Works, New York $265,000. The contract was awarded to the J. P. Morris Co.— Engine house and engine foundations, with caisson complete: Sooysmith & Co., New York, $162,289.55; Donald McDonald, $223,508.85; Shanahan, O'Conner & Co., $236,582.50; W. M. Patton, $253,505.02. The contract was awarded to Sooysmith & Co.—Inlet and river work: Sooysmith & Co., $9,900; W. M. Patton, $17,993; Shanahan, O'Connor & Co., $18,000; Donald McDonald, $18,776.55. The contract was awarded to Sooysmith & Co.

Reservoir Work.—The following proposals for the work of changing the effluent system of the water-works reservoir at Newport, Ky., were received April 2, by B. R. MORTON, Superintendent of Water-Works. The bid of Owen Patterson was informal. The contract was awarded to P. Murray:

Bidders.	Tunnel Excav. per cu yd	Open Cut Excav. per cu yd	Puddling, per cu. yd.	Brick Masonry per 1,000.	Stone Masonry per perch, 25 cu. ft.	Conc'ete per perch, 25 cu. ft.	Stone Paving per sq. yd.	Timber, per 1,000 ft. B. M.	Total.
P. Murray, Cincinnati, O.,	$3.90	$ .70	$ .50	$17.00	$7.00	$5.25	$1.50	$29.50	$11 905.00
Owen Patterson, Baltimore, Md.,	4.75	.70	.85	18.00	4.00	5.50	.75	26.40	12,227.50
J. Hahn, Newport, Ky.,	4.50	1.00	1.00	20.00	9.00	5.00	3.00	40.00	14,620.00
J. Barton, Newport, Ky.,	5.50	.70	2.00	30.00	6.00	6.00	.50	35.00	16,385.00
Thos. J. Peter, Cincinnati, O.,	5.00	1.85	1.50	25.00	5.50	6.00	1.00	25.00	16,442.50
C. J. Limerick, Newport, Ky.,	5.00	1.50	.85	30.25	6.50	5.25	.75	27.00	16,465.00

Pumping Engine and Boilers.—The following proposals for (A) a 2,000,000 galls. pumping engine and boiler at the high service pumping station, and (B) 2 boilers at the low service pumping station, have been received by the Water Commissioners, Yonkers, N. Y.; Jos. A. LOCKWOOD, Clerk and Superintendent:

(A). Bidders.	Class of Engine. High Pressure.	Compound Non-condensing.	Compound Condensing.	High Pressure Condensing.
Gordon & Maxwell Co., Hamilton, O.,	$4 900	$5,600	$6,190	——
Knowles Steam Pump Co., New York,	4,996	6,635	8,988	——
H. R. Worthington, New York,	3 707 4,807	——	6,537	——
Deane Steam Pump Co., Holyoke, Mass.,	5,300	——	8 700	$6,350
National Iron Works, New Brunswick, N. J.,	——	——	6,800	——
Volker & Felthousen Mfg. Co., Buffalo N.Y.,	3,175	——	4,135, 5,250 5,255, 6,675 5,290	——

(B.) For two steel boilers, 65 ins. diameter, 16 ft. long, with 66 3½-in. tubes: Payne & Co., $2,500; Bigelow Co., $2,560; Cunningham Iron Works, $2,750; McNeil & McLachlan, $4,200; Whittier Machine Co., $3,232; National Water Tube Boiler Co., $3,232.—The contract for engine and boiler was awarded to H. R. Worthington, of New York, at $6,537 for a compound condensing engine. The contract for boilers is not yet awarded.

Court Houses.—*Huntsville, Tex.*—The following proposals have been received for the Walker county court house: D. M. Darling, Palestine, Tex., $20,495 for brick building, $24,755 for Burnet granite face with brick backing. Llewellyn & Parish, Huntsville, Tex., $24,300 for Riverside stone building. A. Baumbach, Houston, Tex., $22,994 for brick building, $26,449 for Burnet granite face with brick backing. Lovell & Miller, Brownswood, Tex., $24,250 for brick building, $24,736 for Riverside stone building, $27,760 for Burnet granite face with Riverside stone backing. Brown & Carnes, Longview, Tex., $25,600 for brick building, $27,200 for Riverside stone facing with brick backing. Devern & McFarlan, Navasota, Tex., stone building, $29,481. The contract was awarded to D. N. Darling at $20,495. EUGENE T. HEINER, of Houston, Tex., is the architect.

Union City, Tenn.—The following proposals have been received by W. H. GARDNER, Chairman of the Building Committee: W. W. McCoy, Marietta, O., $18,741; Boon & McGinnis, Paducah, Ky., $18,925; T. L. Brensford, Union City, Tenn., $19,500; M. T. Lewman & Co., Jeffersonville, Ind., $24,939.

Boston, Mass.—The Court House Commissioners have received the following proposals for the erection of the main building from the second floor level: Sampson, Clark & Co., the present contractors, $264,864 with brick and concrete arches, $260,626 with concrete arches; Augustus Lothrop, $333,504, $326,635. An informal bid of $19,800 for the iron work was received from Haugh, Ketcham & Co., of Indianapolis. The work includes furnishing and laying about 9,000,000 brick, setting about 140,000 cu. ft. of dressed granite, and furnishing and setting the iron framing for the roof.

The Champion Steam Track Laying Co. has been incorporated at Chicago by CORNELIUS PRICE, ABNER PRICE and EDWARD D. MOORE. Capital stock, $20,000.

The National Steam Excavating Co. has been incorporated at Minneapolis, Minn. Capital stock, $10,000. President, J. A. HILLIKER; Vice-President, WM. WATSON; Treasurer, A. B. MERRIAM.

Electric Light.—At Little Rock, Ark., the contract for the electric light plant for the city, including all necessary machinery for 90 arc lights and 4 star towers, with mast arms, poles, wires, etc., complete and ready for operation, was awarded Feb. 3 to the Fort Wayne Jenney Electric Light Co., for $27,000; the light to be in operation July 1. F. J. H. RICKON, City Engineer.

Supplies.—The following contracts were awarded by Major A. M. MILLER, U. S. Engineer Office, St. Louis, Mo.: W. D. Bangs, St. Louis, manilla rope, sisal rope and sisal yarn, 10¾ cts., 9¾ cts. and 9¾ cts. per lb.; John Cleary, Chester, Ill., piles, 30 to 35 ft., 36 to 45 ft. and 46 to 60 ft. long, 8, 9 and 10 cts. per ft.; Myron M. Buck, St. Louis, oakum, 8 cts. per lb.; Harry E. Coffin, Memphis, Tenn., spikes, 2¾ cts. per lb.; H. L. Fox & Co., St. Louis, nails, screw bolts and iron, 2.04 cts. per lb., 8.7 cts. each, 1.94 cts. per lb.; Grafton Quarry Co., St. Louis, stone 40 cts. per cu. yd.

Street Railways.—T. Wm. Harris & Co., New York, have the contract for building a belt line at Savannah, Ga., for the City & Suburban Railway. They have recently completed the track for the Savannah Street & Rural Railway.

City Work and Street Railway.—

SANTA BARBARA, Cal., March 31, 1888.

EDITOR ENGINEERING NEWS: The following new construction is now in progress in this city. Paving State St. between Mason and Mission Sts., 60,000 sq. yds., at $2.16; curbing, 94 cts. per lin. ft.; excavation, 28 cts. per cu. yd.; embankment, 20 cts. per cu. yd. Foundation of paving cobbles laid 6 ins., covered with 3 ins. of broken rock; substratum and each course of rock rolled with a 10 ton roller. Surface covering of bituminous rock of a consolidated thickness of 2½ ins. N. P. PERINE, contractor. Also 3,125 ft. of 8 in. pipe sewer, with manholes and street connections; proposals open April 6. The city has just completed the surveys for and has established the official grades on its 90 miles of streets, and is now engaged in thoroughly monumenting all the main traveled streets within city limits. A large amount of private permit work is being done, including the building of some 2 miles of new street car lines. GEO. F. WRIGHT, *City Engineer.*

Well.—The contract for the construction of the large collecting well, for the water-works at Mansfield, Mass., has been awarded by the Water Commissioners to John A. Gill, of Boston, at $8,600.

Railroad Track Wanted.—The Volker & Felthousen Mfg. Co., of Buffalo, N.Y., wants 140 ft. of new or second-hand railroad track.

Locomotives and Cars.—The Jacksonville & St. Augustine Short Line Ry. Co. will purchase standard gauge locomotives and passenger cars. Address the company at Jacksonville, Fla.

Water-Works.—*Corpus Christi, Tex.*—The contract for artesian wells for the new water-works has been awarded to the American Well Works Co., of Aurora, Ill.

Lapeer, Mich.—The Board of Water Commissmissioners have awarded the contract for the water-works to M. Walker, of Port Huron, for $33,700. The works are to be completed by August.

Fencing.—The following proposals for fencing lots, have been received by the Commissioner of City Works, Brooklyn, N. Y.: John Bray, 57 cts. per lin. ft.; Thomas Keenan, 60 cts.; Philip J. Heany, Jr., 65 cts.; Leonard Bros., 97 cts.

Stand Pipe.—The contract for a stand-pipe 100 ft. high and 14 ft. diameter, at Gretna, La., for the Union Oil Co., has been awarded to Thomas & Gorman, of Houston, Tex.

The Kaw Valley Bridge Co. has been incorporated by CALVIN P. FOX, Kansas City, Mo.; THOS. R. SNYDER, E. R. FISHER, W. J. STRONG and K. P. SNYDER, of Kansas City, Kan. The company proposes to build wood and iron bridges. Capital stock $10,000.

Pier Work.—The following proposals for removing the old pier and building new pier at W. 51st St., North river, have been received by the Dock Commissioners, New York City: Richard Cronin, $5,970; J. H. Staats, $26,440; P. Sanford Ross, $27,100; John Gillies, $27,500; John W. Flaherty, $27,975; Joseph Walsh, $28,900; O'Connel & Coffey, $31,900. The contract was awarded to Richard Cronin.

The Texas Capital Granite Co. has been organized at Granite City, Burnet Co., Tex., to mine and quarry granite, marble, etc. P. EXHALL, of St. Louis, Mo., and Dr. W. H. WADDELL, GEO. W. LACY, A. P. WOOLRIDGE, and others, of Texas, are interested. Capital stock, $1,000,000.

Gas and Electric Lighting.—*Troy, N. Y.*—The following proposals have been received by the Board of Contract: Troy Electric Light Co., 47 cts. per light per night, or $41,946.47 per annum for the 262 arc lights; Edison Light & Power Co., 17 cts. per light per night, or $16,250.10 per annum. The joint bid of the gas companies for lighting the entire city, 800 lamps, amounted to $20,000.

Wilmington, N. C.—The following proposals have been received by the Committee on Lights: Electric Light Co., 51 lights, $10.50 per light; Gas Light Co., lamps for streets, $2 per night; alley lamps, $2.50; lights for public buildings, $2 per 1,000 ft.

The Portland Street Sprinkling Co., of Portland, Me., will lay its pipes as soon as the ground is in condition. President, CHARLES J. CHAPMAN; Secretary, B. F. MITCHELL; Superintendent, CHAS. A. KENNARD.

The California & Mexican Improvement Co. has been incorporated at San Francisco, Cal., by W. H. H. HART, J. V. ELLIS, of San Francisco; J. K. LUTTRELL, of Sonoma, and others. The company proposes to undertake contracting work for railways, water-works, sewerage, bridges, land reclamation, harbor works, etc. Capital stock, $10,000,000.

Railway Contracts.—*Buffalo & Williamsville.* The contract for the construction of the road has been awarded to Col. J. E. McIntire, of Buffalo, N. Y.

New York, Pennsylvania & Ohio.—The contract for the double track road-bed between Cleveland and Youngstown, O., with masonry for the same, has been awarded to Drake & Stratton, of Pittsburg, Pa. There were 16 bids. Work was commenced at both ends of the line April 1, and is to be completed by Nov. 1.

Cleveland & Canton.—Paige, Carey & Co. have the contract for building the extension from Coshocton, O., to Zanesville.

Kentucky Midland.—Mason, Ford & Co. have been awarded the contract for the construction of 100 miles of this road.

East Tennessee, Virginia & Georgia.—The contract for filling in the trestles along the line from Macon to Rome, Ga., has been awarded to McDonald, Shea & Co., of Knoxville, Tenn. They will sublet the work.

Macon & Covington.—The contract for grading this Georgia road has been awarded to Hillman & Jackson.

Durham & Henderson.—W. P. Fortune & Co. have a contract for building 13 miles, and Linehan & Co. for 6 miles, of this North Carolina road.

Louisville & Nashville.—The contract for the Huntsville branch, 27 miles, and the Trussville branch, 13 miles, has been awarded to J. W. Worthington & Co., of Birmingham, Ala.

St. Paul, Minneapolis & Manitoba.—Foley Bros., the contractors for the Duluth extension, have sublet a contract to L. F. Johnson and Theodore B. Smith, for 5½ miles of grading, 100,000 ties, 2,500 telegraph poles, and 1,000 piles.

Chicago, Rock Island & Pacific.—The contract for grading the first 12 miles from Colorado Springs, Col., has been awarded to Carlisle & Price, of Pueblo, Col.

Chicago & Eastern Illinois.—Elliott, Huss & Co., 15 Washington St., Chicago, have the contract for grading and bridging an extension from Momence, Ill., to Goodland, Ind., 31 miles. Their headquarters will be at Momence and they will commence work at once.

Hospital.—The following contracts have been awarded for work at the West Tennessee Hospital for the Insane, Bolivar, Tenn.: J. W. X. Browne, Memphis, Tenn.; plumbing and gas pipe, $10,147; steam heating, $17,557; water-works, $3,410. Livermore Foundry & Machine Co., Memphis, Tenn.; iron work, $8,655; boilers, $5,224. Dow Wire Works, Louisville, Ky., wire work, $2,100. MCDONALD BROS., Louisville, Ky., are the architects.

Pumping Engines.—The Board of Public Works, Chicago, Ill., has awarded the contract for pumping engines to E. P. Allis & Co., of Milwaukee, Wis., for 5 engines, $369,785. The list of bids was given on page 280.

Dredging and Tunnel.—The following proposals for work at the flushing tunnel inlet have been received by the Board of Public Works, Milwaukee, Wis.: C. H. Starke, 27 cts. per cu. yd. for dredging, $21,000 for building the inlet: Wm. Forrestal, 35 cts., $23,250. The contract was awarded to C. H. Starke,

Iron Work.—The Riverside Bridge & Iron Works, Paterson, N. J., have the contract for the structural iron for and the erection of the new Pavonia ferry houses at the Jersey City terminus of the N. Y., L. E. & W. Ry.

Worthington Pumps.—The new steamer *"City of New York,"* of the Inman line, is furnished with Worthington pumps for fire, bilge, boiler feed and other purposes.

Water Plugs. The Light & Water Committee Lancaster, Pa., will purchase 6 new water plugs of an improved pattern.

Road Machine.—At Wakefield, R. I., it has been decided to purchase a new road machine for the Narragansett district. Address, Councilman RODMAN.

Bridge Abutment.—The following proposals for the abutment for a bridge across the Great Miami river at Poast Town, O., have been received by RICHARD BROWN, County Auditor, Hamilton, O. The contract was awarded to Cummins & Conner.

Bidders.	Dry Excavation.	Wet Excavation.	Fill.	Timber, M. B. M.	Masonry, per cu. yd.	Piling, per l. f.
	c's.	$	$	$	$	$
Patrick Murray,	25	1.85	.45	24	13.00	11.00
Cummins & Conner	0	1.50	.15	25	11.00	8.70
John B. Reilly,	35	1.00	.50	30	12.00	10.00
Samuel McNail,	28	1.50	1.50	20	8.50	13.80
Devlin & Pugs,	40	.75	1.00	30	10.00	17.25
Drury & Douglass,	20	1.25	.20	40	10.30	16.00

Water Pipe.—*Reading, Pa.*—The Water Board has awarded the contract for 4, 6, 8, 10 and 16-in. pipe to the Mellert Foundry & Machine Co. at $29.50 per ton; also special castings at 2 and 2½ cts. per lb.

Hoboken, N. J.—The following proposals have been recived by the Board of Water Commissioners for 10,000 ft. of 6-in. pipe: Mellert Foundry & Machine Co., Reading, Pa., $28.75 per gross ton; R. D. Wood & Co., Philadelphia, Pa., $29.50 per gross ton; Warren Foundry & Machine Co., New York, $5.11 per length of 12 ft. 3 ins.; Thomas McKenna, $4.70 per length of 12 ft. 3 ins.; Gloucester Iron Works, Philadelphia, Pa., $27.79 per gross ton; Reading Foundry Co., Reading, Pa., $4.63 per length; McNeal Pipe Foundry Co., Burlington, N. J., $5.12 per length.

Newark, N. J.—The Executive Committee of the Aqueduct Board has awarded the contract for pipe to the Mellert Foundry & Machine Co., Reading, Pa.; 16 and 12-in. pipe, $26.65 per gross ton; special castings, 2¼ cts. per lb.; 20,000 ft. of 6-in. pipe, $27 per gross ton.

Water-Works Supplies. The Board of Public Affairs, Cincinnati, O., has awarded contracts as follows: Addyston Pipe & Steel Works; pipe, $29.85 per ton; specials, $100 per ton. Hoefinghoff & Lane Foundry; machine castings, 2¼ cts. per lb; dry sand castings, 3¾ cts. per lb. Alex Riegler; ferrules, ¾-in., 54 cts.; ¾-in., 74 cts.; 1-in., 86 cts.; 1¼-in., $1.60; 2-in., $3.28 each. R. Hesterberg & Co., brass castings, 20½ and 16 cts. per lb. for red and yellow brass. Eureka Foundry; valve boxes, 1.95 cts. per lb; grates and linings, 1.9 cts. per lb.

Depots.—The contract for the Richmond & Danville depot at Asheville, N. C., has been awarded to Elliott & Elliott, of Salisbury, N. C.—A new depot for the Southwest Railroad is to be built at Uniontown, Pa.

Reservoir.—McArthur Bros., of St. Paul, Minn., are about to construct a high service reservoir, with earth embankment and cemented bottom and sides.

Paving.—*Pittsburg, Pa.*—Contracts have been awarded to Booth & Flinn, for block paving at $3.85, $3.87, and $3.95 per sq. yd.; and for vulcanite at $3.25 per sq. yd.

Waterbury, Conn.—The following proposals for 94,000 sq. yds. of granite dimension block paving have been received by F. FLOYD WELD, City Engineer: C. W. Blakeslee & Sons, New Haven, $2.68 per sq. yd.; John H Brown, New London, $2.73; R. L. Bronson, Waterbury, $2.87; Chas. Jackson & Son, Waterbury, $2.92; Edward McManus, Waterbury, $3.25; Theodore A. Madden, Bridgeport, $3.27; Leonard W. Johnson, New York City, $3.49. The contract was awarded to C. W. Blakeslee & Sons.

Copper Speculation.—The following is from correspondence of *The Iron Age*:

We find that trade has *not decreased* any whatever on account of the high price on copper, and we look for a larger trade than ever this year. The jobber and dealer will not lay in a large stock of goods, as they are looking for cheaper copper, but are buying from hand to mouth. When this combination or association of foreign capitalists took hold of copper in this country, the large manufacturers laid in a good stock, and while this metal was up to 16½ to 16¾, we were selling, (that is, the association manufacturers) brass goods on the basis of 14 cent copper. It is not our opinion that if copper is kept up over 15 cts. there will be any decrease in the demand whatever. There is no doubt but what we will have Western copper in the market in a very few months, which the manufacturer will be able to get hold of at prices less than present prices.

Structural Iron.—The manufacturers of beams and channels will have some difficulty in maintaining prices this year. The number will be so increased in the next three or four months, if schemes now projected are carried out, that it is difficult to see how the business can be so controlled as to prevent a serious decline. Several mills now have facilities for turning out small sizes of beams, and some of them intend to add rolls for making larger sizes, while other mills which have not heretofore been engaged in this branch of trade propose to enter it with complete facilities for making all sizes. The West is the field in which the new departure will principally be made.

The decreased profits in other branches of the iron trade are the cause of the broad on the beam trade, which is almost alone in keeping up rates to last year's standard. The demand for beams is constantly growing, more of them now being used in small buildings than would have been thought possible but a short time since. Small Western towns are introducing them in store and office buildings and other structures of a public character. Builders are also finding their suitability in remodeling old buildings or making repairs. It is probable that lower prices may stimulate the demand for them, and increased production will then compensate to some extent for smaller profits. In any event, the changes are now strongly in favor of the reduction of beam prices through the introduction of new competitors. *Iron Age.*

Proposals Open.

Water Works.—A complete system for the military post at Fort Riley. Advertisements will be published shortly. W. H. STAIR, C. E., Fort Riley, Kan.

Railroad.—Laying 50 miles of the track of the Saginaw Div. of the Toledo, Saginaw & Mackinaw R. R., from Durand, Mich., to East Saginaw. Also rolling stock and equipment. WM. DOHENY, Supt. of Construction, Saginaw Construction Co., Room 21 Hoyt Block, East Saginaw, Mich.

Brick Meter Chambers: Scrap.—Building about 20 brick meter chambers. Purchase of about 25 tons of cast and wrought-iron scrap. JAMES B. BOUSTEAD, Chairman, Water-Works Committee, Toronto, Ont., Canada. April 16.

Street Work.—Paving, macadamizing, etc. LOUIS WAGNER, Director of Dept. of Public Works, Philadelphia, Pa. April 16.

Artesian Wells.—Boring 3 wells. Plans and specifications with the city engineer. G. H. COLE, City Clerk, Toledo, O. April 16.

Street Work.—Grading, vitrified fire brick paving, curbing, etc. G. H. COLE, City Clerk, Toledo, O. April 16.

Water Pipe.—Cast-iron pipe, 5 tons (2,000 lbs.) of 10-in., 45 of 8-in., 190 of 6-in., 35 of 4 in.; 14,000 lbs. of castings. THOS. J. NEVILLE, Clerk of Executive Board, Rochester, N. Y. April 16.

Street Work.—Stone crosswalks, plank sidewalks; street sprinkling. H. W. BANNISTER, City Clerk, Syracuse, N. Y. April 16.

Curbstones.—Granite curbstones, 8,000: 6 and 8 ins. at top and bottom, 6 ft. long, 16 ins. deep. Price per lin. ft. D. B. LEONARD, City Clerk, New Bedford, Mass. April 17.

Water Bonds.—City water bonds for $200,000, 3½%. CHAS. A. HILLS, Chamberlain, City Hall, Albany, N. Y. April 17.

Street Work and Sewer.—Grading, curbing and widening; 12-in. vitrified pipe sewer, with catch basins and manholes. GEO. B. GRIMES, City Engineer, Terre Haute, Ind. April 17.

Steam Heating.—Low pressure return circulating steam heating and ventilating apparatus for U. S. building at Dallas, Tex. W. A. FREBET, Supervising Architect, Treasury Department, Washington, D. C. April 17.

Street Paving Composition.—Furnishing and delivering in portable tanks about 1,000,000 galls. of coal tar composition, manufactured and distilled at 400° F., made suitable for street paving purposes and equal to Barrett & Arnolds best paving composition. GEORGE B. SWIFT, Commissioner of Public Works, Chicago, Ill. April 18.

Lumber.—Oak lumber, 250,000 ft.; pine lumber, 223,000 ft. GEO. B. SWIFT, Commissioner of Public Works, Chicago, Ill. April 18.

Pipe Laying.—Laying water service pipes. GEO. B. SWIFT, Commissioner of Public Works, Chicago, Ill. April 18.

Sand and Cobblestone.—Supply for 1888. Separate bids. JOHN P. ADAMS, Commissioner of City Works, Brooklyn, N. Y. April 18.

Road Improvement.—Improving Whitewater State Line road in Whitewater township. FRED RAINE, County Auditor, Cincinnati, O. April 21.

Sidewalks.—Flagging sidewalks JOHN P. ADAMS, Commissioner of City Works, Brooklyn, N. Y. April 23 and May 14.

Street Work. Cedar block paving, stone curbing. WM. BUCHANAN, Chairman of Street Committee, Gladstone, Mich. April 25.

Viaduct.—Iron abutments and piers, stone footings; 650 ft. of iron trestle, 40 ft. roadway, 8 ft. walk; 1 Pratt truss skew span, 150 ft., 24 ft. roadway, 8 ft. walk; 2 Pratt truss deck spans, 103 ft., 24 ft. roadway, 8 ft. walk. For the 14th St. viaduct. LOWRIE & AULLS, Engineers, Pioneer Building, Denver, Col. April 25.

Water-Works.—For Tilbury Centre. Engineer, JAMES A. BELL, St. Thomas, Ont. A. A. WILSON, Village Clerk, Tilbury Centre, Ont., Canada. April 25.

Water-Works.—Pumping capacity of 2,000,000 galls. per day against a pressure of 160 ft. head, 1 compound condensing duplex and 1 high pressure duplex pump, 2 return tubular boilers; 52 hydrants; stand-pipe with capacity of 200,000 galls. and giving a head of 100 ft.; 6,545 ft. of 12-in. pipe, 3,602 ft. of 10-in., 6,384 ft. of 8-in., and 17,300 ft. of 6-in. The source of supply, Little river, is 6,102 ft. from city limits, and if wells could be used that amount of 12 in. pipe would not be needed. No rock excavation expected. The city will grant a franchise, contractors to run and operate the works. Proposals to state price per annum for furnishing water for specified number of hydrants for 30 years from completion of the works. NATHAN O'BERRY, Chairman of Water-Works Committee, Goldsboro, N. C. April 25.

Post-Office.—At Terre Haute, Ind. W. A. FREBET, Supervising Architect, Treasury Dept., Washington, D. C. May 1.

Dredge, Supplies, Etc.,—Dredge, tug, two scows. Also timber, coal, and general supplies. Removing shoals at Sand Beach harbor of refuge, Lake Huron. Lt. Col. O. M. POE, U. S. Engineer Office, Detroit, Mich. May 7.

Jail.—Plans and specifications. F. M. HINES, Clerk of County Commissioners, Tarboro, N. C. May 14.

WATER.

Irrigation in Colorado.—The result of the meeting held in March at Denver, Col., to discuss the question of irrigation, resulted in the adoption of resolutions urging Congress to immediately make appropriations for the construction of reservoirs and canals for irrigation.

Danielsonville, Conn.—At a recent meeting of the borough officers the question of water supply was again taken up. A resolution was passed providing for a committee acting for the borough to make the Crystal Water Co. an offer for a service it is not in a condition to render, and in the event of refusal to apply to the next legislature for such amendments to the borough charter as will enable it to introduce a system of its own. WM. E. HYDE, B. A. BAILEY and S. W. CROFUT were made the Committee. The offer to the water company is to be open 60 days, and if accepted 6 months are to be allowed to prepare for the service. The company has a reservoir 125 ft. above the main street and will only offer to maintain a static head of 110 ft., with a main pipe partly 12 and partly 10 ins. diameter and 3 miles long. The borough has offered to pay the company its price for hydrants if the company will maintain a pressure of 50 lbs. at the main street. The insurance companies threaten to advance all their rates 25 per cent. unless a fire service with 75 lbs. fire pressure is provided.

The Driven Well Patents.—The Supreme Court of the United States has denied the application for a rehearing of the "Driven Well" cases. This is the second application that has been made for a rehearing of these cases.

San Diego, Cal.—The long contested suit between Gov. WATERMAN and the San Diego Flume Co. respecting property in the Cuyacamaca mountains, has been compromised. The flume company secures title to the lands now used for its head works and reservoirs, and the Governor will coöperate with the company in the scheme for supplying the city with water.

Irrigation in Washington Territory.—The Yakima Valley Land & Irrigation Co. has been incorporated by F. A. SEARS and T. C. SEARS, of Tacoma; ROLAND B. KINNE, of North Yakima; and C. A. CONGDON and H. P. BARBOUR, of St. Paul. The capital stock is $500,000. The company will construct and operate a canal 52 miles long, 20 ft. wide at top and 40 ft. wide at bottom, from North Yakima through the Sunny Side region in the Yakima valley to the mouth of the river at the Columbia. It will reclaim about 400,000 acres of land, which will be opened for settlement. Work will be commenced at once.

Public Improvements in Mexico.—According to despatches from the City of Mexico the general feeling is that the placing of the loan of $18,000,000, effected recently, will insure prosperous times in Mexico for several years to come, as the Government will now be able to meet all of its obligations without incurring any indebtness to the National bank, and will have besides a surplus for public improvements. It is understood that the Government proposes to invest $1,000,000 in the drainage of the Valley of Mexico. The net proceeds of the loan will be about $15,000,000 in Mexican currency.

Candelaria, Nev.—The Candelaria Water-Works & Milling Co. holds the monopoly in perpetuity of the water from the nearest springs, situated in the White mountains, capable of furnishing an ample supply of water per day (free of all royalties or payments of any kind), and owns a line of pipes from the springs to the town, a distance of about 30 miles, which has been successfully laid. The works are in full operation and are now supplying water to the town and mines, and producing a considerable annual revenue. Until the establishment of the water-works of this company, the inhabitants and the numerous mines in this district were practically unprovided with water, which is an essential necessity for the proper working of the mines.

Irrigation in New Mexico—The West Side Canal Co., of Albuquerque, N. M., has elected the following officers: President, C. H. GILDERSLEEVE; Vice President, THOS. SMITH; Secretary and Treasurer, J. F. CHAVER; General Manager, P. A. SIMPSON. It is the intention of the company to commence work at an early day, the entire route, nearly 150 miles, having already been surveyed. It starts at the Indian village of San Felippe, following the Rio Grande on the west side of Albuquerque, re-emptying into the river a few miles below Socorro. There are about 250,000 acres, now practically useless, that will be irrigated by this canal.

Greenville, Miss.—The Greenville Water-Works Co. was organized March 31, under a charter granted some time ago and $25,000 of the stock was at once subscribed for by the incorporators. It is intended to obtain a supply from artesian wells, with a connection to the river for fire purposes; if the wells do not furnish a sufficient supply for domestic use, water will be taken from the river and filtered. The contracts have been let and some of the material has been delivered. Work will be commenced as soon as the City Engineer has completed the profiles of the streets in which pipes are to be laid. The works will cost between $65,000 and $75,000 and are expected to be completed in 4 months. President, L. METESSER, New Orleans; Vice President, JOSHUA SKINNER; Secretary, JOHN FINLAY; Treasurer, A. POLLOCK, Superintendent, JAMES BURKE.

Submerged Pipe.—In lengthening the feed pipe lately in the Magog river at Sherbrooke, Que., the water company of that place secured the services of a diver in order to ascertain if the additional length of 400 ft. rested properly on the river bottom. The diver went down under the ice and found that, at a certain point, the tube rested on a large tree stump. The diver spent 2 hours cutting this stump 12 ft. under water.

Beverly, Mass.—The following is a summary of the report of the committee on an independent water supply: The appropriation made was $150,000, of which amount $141,392.23 had been expended, of which $12,500 had not been contemplated when the appropriation was made. The principal amounts were for pipes, $68,597.11. There had been 10,330 ft. of 18-in. cement lined pipe, 26,256 ft. of 12 and 13-in. pipe, 865 ft. of 8-in. pipe and some smaller pipe. The pumping station, including engines, steel boilers, etc., cost $33,626.86; reservoir, $17,372.15; engineer's house, $2,904.77. The pumps raised 195,000,000 galls. of water during the first 7 months at a cost for pumping of $10.48 per 1,000,000 galls. raised 125 ft. making it 174 ft. above tide water level. This is 31 ft. 9 ins. higher than the Salem reservoir. The old pipe in the town is all guaranteed for 5 years and the new pipe for 15 years, by George H. Norman, the contractor. The cost to the town under the contract with Salem was $16 248 per year, while under the independent system the cost for pumping will be but $4,000 per year. The reservoir has a capacity of 325,000,000 galls. and the two Gaskill pumps have a daily capacity of 2,000,000 galls. each.

Water-Works.—*Maine.*—Portland. The Diamond Island Water Co. will enlarge its plant, put in a new wind engine, build a new reservoir and extend its pipes.

New Hampshire.—Dover. The County Commissioners are giving a hearing on the question of what the city shall pay for the plant of the Cocheco Water Co., which is to be used for the city water-works. The company wants $105,000. The stock is said to have been very valuable, dividends have run from 7 to 13 per cent.

Massachusetts.—Ipswich. The town has voted $500 for the new reservoir.——Boston. The main pipe connecting Fisher Hill and Chestnut Hill reservoirs burst April 5.——Fairhaven. The town has voted to contract with the Fairhaven Water Co. for a water supply. The supply will be drawn from Mill pond for fire purposes and from artesian wells for domestic use. There will be a stand-pipe 100 ft. high, with a capacity of 235,000 galls. The pressure will be 40 to 50 lbs., with direct fire pressure of 90 to 100 lbs. The contract is for 20 years and calls for 30 hydrants at $50 each per annum. The charter is owned by ORSON G. STANLEY, and JOSEPH K. NYE, of Fairhaven. Capital stock, $50,000. A survey has been made by Engineer CROWELL, of Vineyard Haven.——Blackstone. The proposed appropriation for pipes and pumping station for fire protection for the village of Millville has been defeated.

New York.—Albany. The Special Water Commission has arranged with Andrews Bros., the contractors for the driven wells, for an increase of 5,000,000 galls. in the water supply.——Geneva. A vote will shortly be taken on the contract with the water company for water for 100 hydrants at $45 each.——Sidney. Outside parties are said to be interested in the water-works project and to be negotiating with C. C. WILLIAMS, the owner of the artesian well.

Pennsylvania.—Reading. The Water Commissioners have selected Shepp's Dam, about 2 miles above the city, as the point from which water will be pumped from the Schuylkill into the city reservoirs as soon as the necessary pumping machinery can be erected.——Chambersburg. The Borough Council has decided to refund the indebtedness of the borough, which consists of $92,500 of borough and water bonds, and to advertise for proposals for the new bonds. The present bonds are all due and payable and bear interest at 6 per cent. per annum.

Ohio.—Norwalk. The proposition to bond the city for $50,000 for water-works has been defeated.

Indiana.—Jeffersonville. The Jeffersonville Water Supply Co. has purchased land in Port Fulton on which to erect the stand-pipe, instead of in the city park.

Tennessee.—Bristol. A franchise for water-works has been granted to Mr. TAYLOR, of Philadelphia. The franchise is not exclusive and the city does not bind itself to take water. The supply will be obtained from the King spring.——Murfreesboro. A contract has been let for water-works to cost $6,975. Work will be commenced shortly and completed in 4 months.

Alabama.—Decatur. Pipe is being distributed for the new $300,000 system of water-works.

Florida.—Madison. Water-works are contemplated. Address W. T. DAVIS and W. H. HAUSMAN.

Minnesota.—Duluth. The water mains on E. 1st. St. burst recently, causing damage to the amount of $5,000.

Kansas.—Stockton. The water-works bonds for $30,000 have been bought by the State at par, with 5% interest.——Norton. The National Water Supply Co., of Cincinnati, O., will put in a system of Wagner steamed wells.——Horton. The railroad company's well is said to have struck an abundant supply of water at a depth of 44 ft.

Nebraska.—Chadron. Bonds for $35,000 for a complete system of water-works were voted April 4.——Crete. The water-works are to be completed by July. Strang & Co., of Omaha, the contractors, have selected sites for the reservoir and pumping station. The reservoir will hold 1,000,000 galls. and the supply will be taken at 20 ft. below the bed of the Big Blue river.

Montana.—Helena. It is reported that water will be turned on in a few days. The company lays pipes to the curb line, and consumers have to put in the service pipes.

Canada.—Parkhill, Ont. Water works are proposed. Address Deputy GIBBS or Mr. GRIFFITH.——London, Ont. The trouble between the city and London West corporations over the water-works dam, will be settled amicably.——Chicoutimi, Que. Water-works are projected.

Louisville, Ky.—The amendment to the city charter changing the control of the public pumps and wells has been passed by the Legislature and signed by Gov. BUCKNER, and the books have been transferred from the City Engineer's Department to the Board of Health. Dr. GALT will be the Superintendent of the Pump Department, and in addition to his other duties Mr. DICK JACOB will act as clerk. Under the provisions of the amendment the Inspector of Pumps will be appointed by Mayor JACOB and Health Officer GALT.

Treatise on Water Supply.—A prize of $4,850 is offered by the King of Belgium for the best work on the means of supplying good, cheap, and abundant water for large towns, especially for Brussels and its suburbs. The essays may be either in print or manuscript, and may be written in French, Flemish, English, German, Italian or Spanish. A new edition of a printed work cannot be entered in the competition, unless important additions are made to it within the period of the competition, viz., in one of the years 1889 to 1892 inclusive. The essays are to be sent to the Minister of Agriculture, Industry and Public Works, Brussels, before Jan. 1, 1893.

The Baltimore County Water Co. is to be incorporated by JAMES G. WILSON, H. C. TURNBULL, Jr., HENRY L. BROWN, JOHN T. ENSON, J. J. LINDSAY, and others, to operate in the villages of Towsontown, Lutherville, Govanstown, Md., and vicinity. Capital stock, $50,000.

St. John's, Que.—Dr. H. W. WOOD has declared the water supply to be impure and unwholesome and to be the cause of the typhoid fever and other sickness which has prevailed during the past 4 months. A considerable amount of sewage flows into the river above the inlet. He thinks the location of the town is healthy and that the water of the Richelieu river is as good as that of any other river in Canada, but it should be taken at a proper point and conducted to the town in such a way that it cannot be contaminated. He recommends that the present supply of water should not be used for domestic purposes without being boiled.

A Gas Bill for New York.—A bill has been introduced in the New York State Senate by E. F. REILLY, the main feature of which is a provision for the appointment of a gas commission of 3 members, the appointment power to be with the Governor, subject to confirmation by the Senate. If the bill becomes a law the Board of Gas Commissioners will have jurisdiction over all companies, corporations, and persons who manufacture or supply gas for illuminating or fuel purposes in the State. They will have power to issue subpœnas for all witnesses, and administer oaths, and to examine the books and affairs of any corporation affected by the bill. They will have power to prescribe the form of reports required by them from the gas companies, and to keep such books or accounts as they may deem necessary. The bill will compel the gas companies to use meters which will refuse to register unless they have some ground for doing so, and to furnish appliances for preventing the waste of gas, and also for properly testing its quality, illuminating power, and pressure.

Irrigation in California.—A considerable amount of irrigation work is being done in Placer county, principally in connection with fruit culture, and the old mining ditches are made use of as irrigation ditches. Water for irrigating the fruit belt is supplied mainly by the Bear River canal system, which, with its branches and projected lines now being constructed, is the largest single system in central California. The dam from which the water is taken, is on Bear river, about 2 miles above Colfax. Thence the water is taken by the main canal, running southerly to the foothills below, and distributed by various branches wherever required. The system, including the Little Bear River canal, which takes water from Bear river about 15 miles below the main dam, comprises an aggregate length of nearly 300 miles. These Bear River canals are the oldest in the State, having been commenced in 1851 and were built for the purpose of supplying the mining demand, at a cost at that time of $1,100,000, and yielded then an annual revenue to the owners of $100,000. Since then hydraulic mining has been shut off, but with its decline the demand for water for irrigating purposes increased and the present owner of the Bear River system, F. BIRDSALL, is now actively at work on further extensions, capable of supplying, when completed, a large additional area of the foothill lands not covered by the present ditches. Arrangements have been made to largely increase the natural head of water owned by the canal company, in order to give additional supply during the months of June, July, August and September, when the demand is greatest for irrigation.

Connected with the Bear River canal system and forming a part of it, are the water systems supplying the towns of Auburn and Newcastle, and canals are now being constructed to supply Penryn, Loomis, Rocklin and possibly Roseville with additional supply. Besides the Bear River canal, another system, called the North Fork ditch, supplies a portion of Placer county lying east of the railroad and below Newcastle. This is also an early mining ditch, now utilized for irrigating purposes. This ditch takes water from the American river opposite Auburn, 2 or 3 miles below the junction of the middle and north fork of the American. This ditch was built in 1852-53 to convey water to the mines on the north bank of the American, and has carried water to within 15 miles of Sacramento city. The water right is a valuable one, having a large and unfailing supply. This property now belongs to several residents of Sacramento, who will increase the capacity of the canal. The length of this system is about 45 miles.

Special Reports of Water-Works Construction.

GOLDSBORO, N. C., April 9, 1888.

EDITOR ENGINEERING NEWS:

Contracts for water works at this place will be let by city April 25. The source of supply, Little River, is about 6,100 ft. from the city. Wells have been thought of, but our proposals call for pumping the distance above specified to a stand-pipe of not less than 200,000 galls. capacity, and high enough to give a head of 100 ft. at a given point in the city. Besides the stand-pipe there will be 2 pumps, 2 boilers, 52 hydrants, and about 6 miles of 12, 10, 8 and 6-in. mains. The city of Goldsboro wishes to grant a 30 years franchise with a rental per hydrant for works as described above. NATHAN O'BERRY is Chairman of Water-Works Committee.

T. H. BAIN, *City Clerk.*

OMAHA, Neb., March 30, 1888.

EDITOR ENGINEERING NEWS:—

The A. L. Strang Co. have a contract to build water-works at Norfolk, Neb. Works will be built on the franchise plan. There will be 5 miles of pipe, a stand-pipe 12 ft. in diameter and 100 ft. in height, located 60 ft. above business portion of the city. There will be two Knowles pumps, one high pressure and the other compound and each of 2,000,000 galls. capacity. The water supply is by wells and a pipe connection with a branch of Elkhorn river. Messrs. Strang & Co. have other contracts in view, of which I shall be pleased to inform you in the future.

C. F. MCLAIN.

MORRISON, Colo., April 2, 1888.

EDITOR ENGINEERING NEWS:

We are negotiating to lay about 800 ft. of additional pipe, and to build a new reservoir which will give us 45 lbs. pressure. Our population is 250.

W. S. SMITH, *Sec. Morrison Water Co.*

Annual Reports.

East Saginaw, Mich.—The Board of Public Works has presented to the Council its report for 1887, being the 3d annual report, together with the reports of the Clerk, City Engineer and Superintendent of Streets. Statements of cost are given of individual items of public works. The city engineer's report gives particulars of contract prices, etc. There are 12.69 miles of paved streets, (8.61 miles cedar blocks, 4.08 miles cedar block and cobblestone), 8 947 miles of brick sewers, 15,056 miles of pipes sewers, 805 sewer basins, 885 manholes, 8,913 mil-s of tile drains, and 40 miles of water mains. The engineer recommends the drainage and macadamizing of earth streets, to improve their present muddy condition; he estimates the cost as follows for 100 ft. of street, graded, underdrained and macadamized in the center 12 ft. wide and 10 ins. deep:

1333⅓ sq. yds. macadam, 75 cts.	$100.00
200 yds. excavation, 25 cts.	50.00
200 ft. 3-in. tile, $15.30 per m.	3.06
12⅛ rods tile laid, 1.25	15.12
Incidentals, engineering, etc.	5.00
Total	$173.18

This improvement would therefore cost about 86½ cts. per ft. front. The report contains complete and detailed statements and tables of work done. JOHN J. GRANVILLE is City Engineer.

Baltimore, Md.—The Water Commissioners have issued their report for 1887. During the year about 24¼ miles of 1½-in. to 20-in. pipe were laid and 54 additional hydrants set. There are 784 meters and 238 indicators in use. The total consumption for the year was 1,481,762,547 galls. The total amount of pipe laid to Jan. 1, 1888, was 358 miles, with 3,461 stop cocks and 4,801 branches. Work is to be commenced on the Eastern high service reservoir, and the pumps of the temporary supply will be moved from Meredith's Ford to a point within the city. Tables are given of the details of the Jones' Falls and the Gunpowder water supplies. ROBERT K. MARTIN is Chief Engineer.

St. Paul, Minn.—The Water Commissioners have issued their report for the year ending Nov. 30, 1887, being the 6th annual report. During the year, 20 miles 2207 ft. of pipe were laid, including high and low service. The distribution system, on Dec. 1, 1887, comprised the following: low service pipe, 288,749 ft.; high service pipe, 259,720 ft.; total, 103 miles 4629 ft.; 4½ miles of brick aqueduct, 5½ × 6 ft., with waste weirs and gate-houses; 17 Holly and 851 Mathews hydrants, total 868, of which 64 are in West St. Paul; 137 sprinkling hydrants; 526 low service valves; 441 high service valves; total 967; and 249 meters. The total amount pumped was 333,954,800 galls. A contract has been made with McArthur Bros. for the construction of a high service reservoir with a capacity of 16,600,000 galls.; elevation, 310 ft. above city datum; cost, about $130,000. A 16-in. pipe has has been laid across the river by contractors MacRitchie & Nichols. The following is Superintendent JOHN B. OVERTON'S estimate of work for 1888, including high and low service.

Pipe, 4 to 36-in., 4872 tons (24⅝ miles),	$31	$151,032.00
Special castings, 133 tons	$60	7,980.00
Loam castings, 25 tons	$100	2,500.00
Gates and gate boxes		8,341.00
Fire hydrants, 250	$55	13,750.00
Lead, 80 tons,	$100	8,000.00
Hemp packing, 3 tons	$125	375.00
Excavation and laying		65,000.00
Extra for rock excavation		10,000.00
Drayage, 6,000 tons in city limits,	60 cts.	3,600.00
Drayage of pipe and specials for reservoir, 335 tons,	$1.75	586.25
For privilege pipe		10,000.00
Total		$281,164.25

RECORD OF NEW WATER-WORKS CONSTRUCTION.

(Specially Communicated.)

(CONTINUED FROM PAGE 282).

Kearny, N. J.—The works were commenced Sept. 15, 1887; they were designed by VANDWYNE & YOUNG, and DAVID YOUNG was Constructing Engineer. The contractors were Wade and Egan, of Harrison, N. J.; the pipe was supplied by M. J. Drummond, of New York; the 91 hydrants by the Ludlow Valve Co., of Troy, N. Y., and the valves by the Galvin Brass & Iron Works, Detroit, Mich. The contract price was $60,000 for the works complete. The town has a 10 years contract with Jersey City at 9 cts. per 1,000 galls.; Kearny township owning the pipes and laterals. The Water Committee is composed of WM. DAVEY, M. M. FORREST and WM. GREEN. The population in 1887 was 10,000.

Middletown, Del.—The works were commenced in July, 1887; they were designed by Prof. R. A. CAIRNS, C. E., Rensselaer Polytechnic, Troy, N. Y., who also acted as Constructing Engineer. The works were built by the town, money being raised by bonds. The pumping machinery was furnished by Henry R. Worthington, New York; the pipes, specials, valves and hydrants by R. D. Wood & Co., Philadelphia; and the stand-pipe, 100 ft. high and 8 ft. diameter, by Tippett & Wood, Phillipsburg, N. J. The trenching and pipe laying was done by John H. Austin, New Britain, Conn.; the prices for trenching and pipe laying were 15 cts. per ft. for 4-in., and 18 cts. for 6 and 8-in. pipe. The works are managed by the Water Commissioners; President, HENRY CLAYTON; Secretary, M. B. BURRIS. The population in 1887 was estimated at 3,000.

Battle Creek, Mich.—The works were commenced April 18, 1887, and accepted Aug. 10, 1887; they were designed by MACRITCHIE & NICHOL, and W. W. BRIGDEN was Consulting Engineer. The contract for all the original work was taken by MacRitchie & Nichol, of Chicago, but M. Philbin, of Chicago, laid two additional miles of pipe and the city also laid some pipe. There are now about 12 miles of mains. The stand-pipe is of iron, 75 ft. high, on 10 ft. of masonry; the top is 200 ft. above the business part of the city. The following prices were paid for pipe laying and trenching: 4-in., 17 cts.; 6-in., 18 cts.; 8-in., 22 cts.; 12 in., 28 cts.; 16-in., 35 cts. The works are owned by the city. President of the Water Commission, E. C. NICHOLS; Secretary, W. C. GAGE; Acting Supt., W. W. BRIGDEN. The population in 1887 was 12,000.

Greenleaf, Kan.—The works were built in 1887, and accepted Jan. 2, 1888; they were designed by JOHN W. NIER, of Kansas City, Mo.; and KENNETH ALLEN, of Kansas City, was Constructing Engineer. The National Water Supply, of Cincinnati, O., contracted to furnish a supply from steamed wells on the Wagner system; E. Sutphin, of Clyde, Kan., furnished all materials and built the works, with the exception of the wells. The prices paid for trenching and pipe laying were 86 cts. per ft. for 4-in. and $1.15 per ft. for 6-in. pipe. The stand-pipe is 100 ft. high. The works are owned by the city; W. P. MUDGETT, City Clerk. Population 1,500.

(TO BE CONTINUED).